HP mc-Series 5042 Rack Site Preparation Guide

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Preface

Safety and regulatory information

For your protection, this product has been tested to various national and international regulations and standards. The scope of this regulatory testing includes electrical/mechanical safety, radio frequency interference, acoustics, and known hazardous materials. Where applicable, approvals obtained from third-party test agencies are shown on the product label.

Notational conventions

Warning:
Warnings highlight procedures or information necessary to avoid injury to personnel. The warning should tell the reader exactly what will result from what actions and how to avoid them.

Caution:
A caution highlights procedures or information necessary to avoid damage to equipment, damage to software, loss of data, or invalid test results.

Note:
A note highlights supplemental information.

Acronyms and abbreviations

Acronym/ abbreviation	Definition	Acronym/ abbreviation	Definition
BSPP	British Standard Pipe Parallel	NPT	National Pipe Thread
CHWS	Chilled water supply	NPTF	American National taper pipe thread for dry-seal pressure-tight joints
CHWR	Chilled water return	MCS 5042	mc-Series 5042 Rack
CTO	Configure to order	PTFE	Polytetrafluoroethylene
FRU	Field Replaceable Unit	TN Grounding	Grounding specification
HEX	Heat Exchanger Unit	GOW	Gas, oil, water
LAHJ	Local Authority Having Jurisdiction	WSP	Water steam pressure

Safety in material handling

Warning:
Do not lift the cabinet manually. To avoid physical injury you must use a mechanical lifting device.

Warning:
Use care when working with hazardous voltages. This equipment might be configured with dual input line sources. Hazardous voltages and energy might be present even after the removal of a single input source. Trained service personnel must follow the service guidelines. Verify that the differences in ground sources meet LAHJ.

Warning:
Do not stand in front of the equipment as it is rolled off the pallet onto the ramps. When removing the equipment from the shipping pallet, follow the guidelines specified in the Installation Procedures section of the appropriate equipment guides.

Japanese notice

この装置は、クラスB情報技術装置です。この装置は、家庭環境で使用することを目的としていますが、この装置がラジオやテレビジョン受信機に近接して使用されると、受信障害を引き起こすことがあります。取扱説明書に従って 正しい取り扱いをして下さい。VCCI-B

Chapter 1: Overview

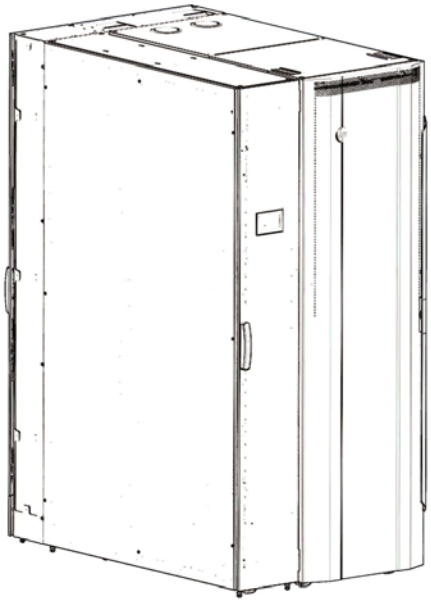
The HP mc-Series 5042 Rack ("MCS 5042") is a supplemental cooling system for the data center that offers two configuration options:

- Preconfigured with a single HP 642 1200mm IT rack enclosure (Figure 1A)
- Configured to support two HP 642 1200mm IT rack enclosure (The second IT rack is a field-installed option, as shown in Figure 1B).

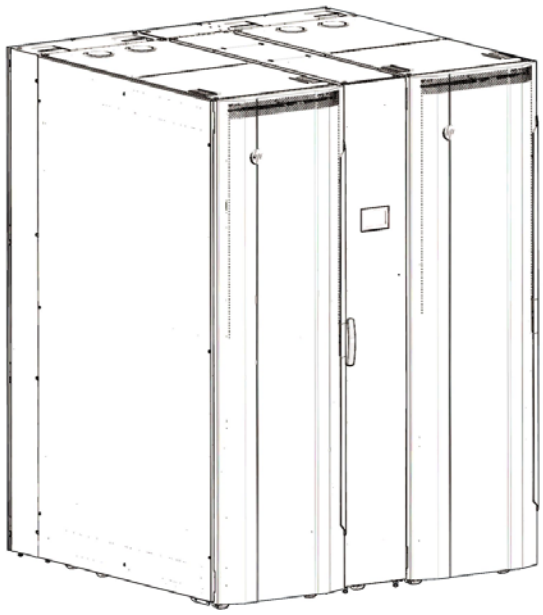
Throughout this chapter, to ensure that all data is considered for a successful site preparation, the various specifications and aspects of the system are defined.

Figure 1: MCS 5042 configuration options

A: Single Rack (standard) Configuration



B: Dual Rack Configuration



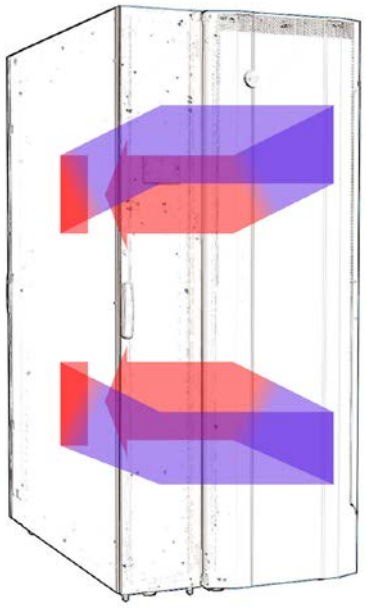
To provide dedicated cooling of servers and other IT equipment, the MCS 5042 integrates with the facility chilled water plant or a dedicated chilled water loop. To supply the MCS 5042, HP recommends that you install a dedicated cooling loop. The system provides cooling, recirculation, and condensation management, and it requires a small amount of AC electric power. Internal monitoring and control sensors assure server inlet air set points are achieved and provide constant performance feedback through local and network interfaces.

Product overview

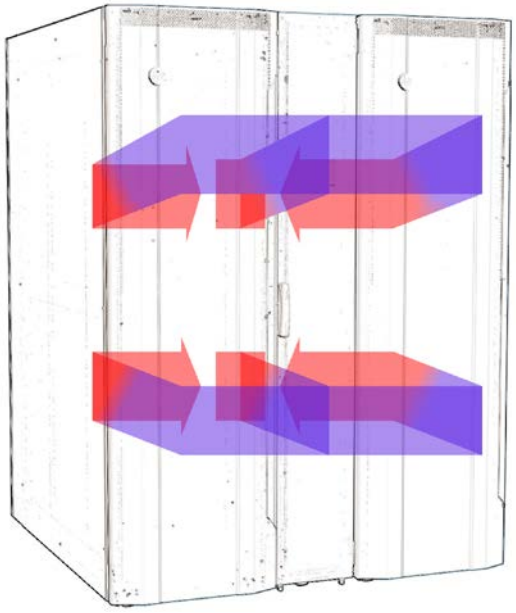
The MCS 5042 is a modular, distributed cooling solution that removes the high levels of heat generated by current advanced server and mass storage systems. The MCS 5042 provides a uniform, effective, affordable, and distributed cooling approach for servers and other IT equipment installed in server racks. The MCS 5042 is a closed-loop cooling system integrated as part of a nonventilated server enclosure, in contrast to a conventional "open" server enclosure with perforated front and rear doors.

Figure 2: MCS 5042 air flow

A: single -rack (standard) configuration



B: Optional field-installed dual-rack configuration



The special horizontal air flow of the MCS 5042 fully supports the industry-standard front-to-back cooling principle (such as cold air drawing into the front of the server and warm air being expelled out the rear of the unit). All devices receive adequate and evenly distributed cool air, regardless of the mounting position within the enclosure. The MCS 5042 distributes precisely cooled, targeted air flow evenly across the front of the IT equipment. Next, warmed air is channeled from the rear of the IT equipment into the side-mounted MCS 5042, cooled, and then re-circulated back to the front of the equipment stack. In the dual-rack IT configuration, the left side panel of the MCS 5042 cooling unit is removed to provide cooling and air recirculation for an additional IT rack. In this configuration, the cooling capacity of the MCS 5042 is divided between the two IT racks.

Key MCS 5042 components

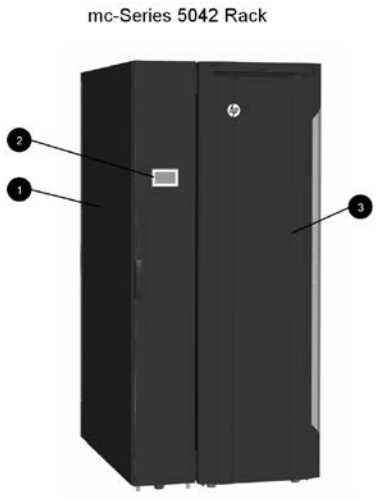
The MCS 5042 key components that work together to provide cooling performance include:

- Main breakers—Provides power for the MCS 5042 through circuit breakers (do not control power at the input panel*).
- Heat Exchanger Module (HEX)—Includes an air-to-water heat transfer device specially created for demanding data center environments.
- Display—Provides general cooling unit status.
- Management module—Provides users with web-based capabilities to set, monitor, and control temperature within the modular cooling unit and displays the health of the unit.
- Fan controller—Operates the fans, according to the cabinet air temperature.
- Air bleeder valve—Enables air to bleed out of the system manually when coolant is initially filled.
- Water controller—Senses for condensation, leaks, water temperatures, flow rate, and the status of the water valve and reports this information to the management module.
- AC input/network connection—Provides primary and (if available) secondary AC input connections and management network interface.
- AC transfer switch—Provides dual-AC power with a fail-over feature for redundancy.
- Fans—Provides circulation of cooled air through the computer equipment rack.
- Water group—Includes the water valve, flow meter, check valve, and temperature sensors.

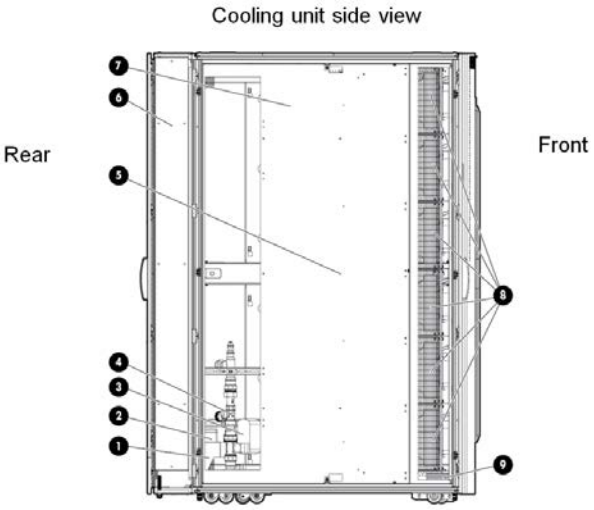
  A condensation pump with overflow and condensation lines connects to the water group. Each MCS 5042 has one water group.

* If the MCS 5042 is still connected to a power source, voltage is applied before the circuit breakers at the input panel.

Figure 3: MCS 5042 component locations

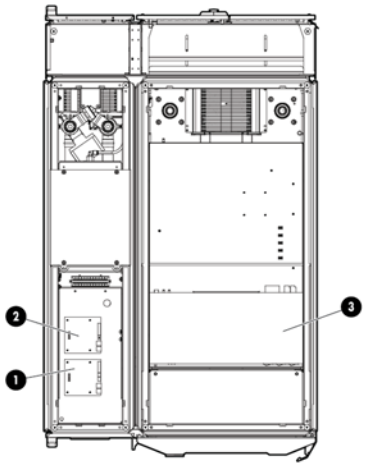


Item	Reference
1	Cooling unit
2	User display
3	IT rack



Item	Reference
1	Condensation pump
2	Condensation pump controller
3	Control valve
4	Flow meter
5	Humidity sensor
6	Rear extension
7	Heat exchanger unit
8	Fan units
9	Management module

Unit top view



Item	Reference
1	Water module
2	Fan module
3	AC transfer switch

MCS 5042 specifications

Physical specifications

Table 1: MCS 5042 physical specifications of a standard single rack and server cabinet configuration

Parameter	Packaged system (as shipped on pallet)	Unpackaged system (off pallet, unwrapped)	Unpackaged CTO system
Height	2285 mm (90 in)	2007 mm (79 in)	2007 mm (79 in)
Width	1219 mm (48 in)	904 mm (35.6 in)	904 mm (35.6 in)
Depth	1829 mm (72 in)	1510 mm (59.5 in)	1510 mm (59.5 in)
Weight	732 kg (1614 lb) [1]	478 kg (1054 lb) [2]	1521 kg (3353 lb) [3]

[1] Weight for a completely packaged system with unpopulated server rack

[2] Weight for an unpackaged system with unpopulated server rack

[3] Approximate weight for an unpackaged CTO system (Actual weight varies, according to configuration.)

Note:
If the top shipping bracket interferes with deploying the MCS 5042, you can remove it. With the top shipping bracket, the total height of the unpackaged system is 2069 mm (81.5 inches).

Electrical specifications

Table 2: MCS 5042 electrical specifications

Parameter	Value	Comments
Operating voltage	208/230 VAC +/- 10%, 50/60 Hz	
AC line phase	Single	
Maximum input current	18 A	Per line cord
Maximum inrush current	200 A	Per line cord
Dropout/hold-up time at minimum line voltage	20 ms	
Transfer time of AC transfer switch	2 s	
Circuit breaker rating	LAHJ	Per cord
Power factor	> 0.95	At all loads
Ground leakage current	< 19.4 mA	Per line cord
Rated power consumption	2800W	Steady state
Power cords (included with the MCS 5042)	208 V, 20 A	NEMA L6-20-to-Procon 700105 (Qty 2)
	250 V, 16 A	IEC 309-to-Procon 700105 (Qty 2)

Chapter 2: Facility planning for MCS 5042 implementation

Overview

The MCS 5042 offers an incremental data center cooling solution, capable of cooling 50 kW of heat from one IT rack or two IT racks. The two basic methods to deploy the MCS 5042 are as a standalone unit or placed in a row adjacent to other MCS 5042 or standard equipment racks.

In planning water supply and design, take into consideration short-term and long-term needs for cooling. Immediate supply needs must meet the specifications and target cooling requirements, based on the parameters defined in this site preparation guide. In anticipation of future heat loads, design and install dedicated loop chilled water piping, based on specific cooling load increments (such as 50 kW or 250 kW), the specific number of MCS 5042 per row or loop, and other site build-out planning parameters. As cooling, rack space, and equipment density requirements increase, you can add MCS 5042 units to the chilled water system.

The chilled water piping system can be routed three ways:

- Routed overhead and the top into the cabinet
- Above the floor and connected through the rear of the cabinet
- Under the floor and routed through the raised flooring and through the bottom of the unit

Note:
Installation service for the MCS 5042 is order number UE005E.

Note:
For site evaluations and technical consulting for your site, see the HP Services website:
http://www.hp.com/services/criticalfacilities

Note:
The implementation of the MCS 5042 aligns with Data Center Best Practices. For more information, see *Optimizing Data Centers for High-Density Computing* which can be found on the HP website:
http://h18004.www1.hp.com/products/servers/proliantstorage/racks/10000series/documentation.html

This chapter discusses key issues for site preparedness, including:

- Space considerations (for delivery, operation, and service) and other related considerations (such as floor loading)
- Electrical considerations
- Coolant source options and quality considerations
- Other considerations

A complete site preparation checklist is provided in Appendix A.

Space and positioning considerations

The MCS 5042 is larger (and, when fully populated, heavier) than a standard 19-inch equipment rack. Therefore, space required for maneuvering, operating, and servicing the MCS 5042 is greater than standard-sized racks.

Delivery space requirements

You must ensure the facility has adequate space to receive and remove the MCS 5042 from the shipping pallet. When unloading the MCS 5042, take into consideration the following:

- Forklifts must enter and transport the shipping pallet from the side.
- Delivery plans must include the possible removal of walls or door.
- A total length of approximately 6.1 m (20 feet) must be allowed to safely remove the MCS 5042 from the shipping pallet down the provided ramps.
- The packaged dimensions of the MCS 5042 preconfigured with a single IT rack are (including shock pallet and cartons):

  2285 mm (90 inches) height x 1219 mm (48 inches) width x 1829 mm (72 inches) depth

Maneuvering space requirements

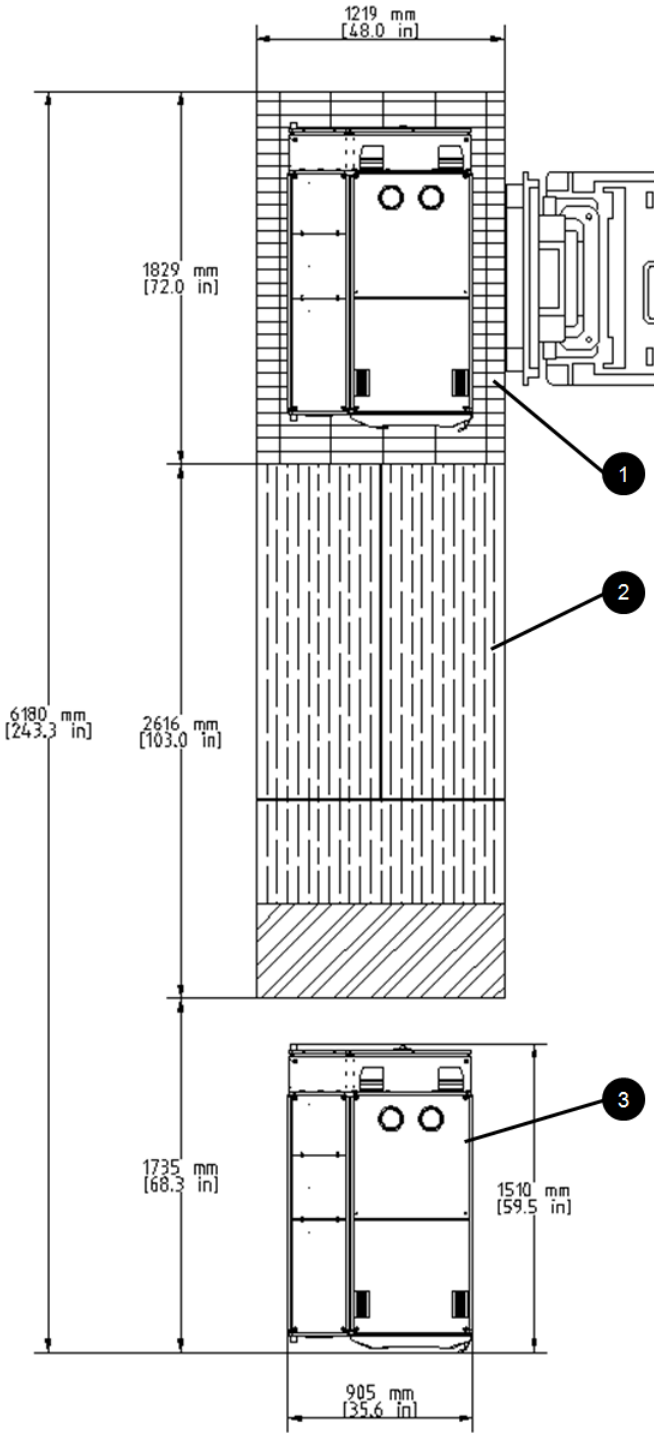
When maneuvering the MCS 5042, use the following guidelines:

- Racks with casters must be moved with care. Sudden stops, excessive force, and uneven surfaces might cause the product to overturn.
- Both the cooling unit and the IT rack have casters that are fixed at the front and swivel in the back due to stability and safety concerns. Therefore it is easier to move the MCS 5042with the back as the leading edge.
- For long, straight distances roll the MCS 5042 with the front, fixed casters leading. For better mobility lead with the rear, swiveling casters.
- When rolling the MCS 5042, push firmly on the front doors frame and not the door mesh of the IT rack. The points on where to push the MCS 5042 are marked by factory.
- Make sure the rooms and doors are large enough to accommodate the movement of the MCS 5042 cabinet into the data center.
- When transporting the MCS 5042 to a different building floor, be sure elevators have adequate load capacity, floor space, and door clearance to accommodate the rack. The MCS 5042 pallet can only be moved with forklifts from the side, which has a length of 1829 mm (72 inches).
- When transporting the MCS 5042 within a building, be sure that doorway thresholds are adequate to hold the rack. HP does not recommend that you lift or transport the MCS 5042 by eyebolts that are attached to the upper corners of the cabinet.

Warning:
To reduce risk of personal injury or damage to the equipment, a single person must not attempt to move equipment racks alone. Obtain adequate assistance to stabilize the rack during movement or hire professional equipment riggers.

Figure 4 shows the maneuvering space required when unloading the MCS 5042 from a pallet. When planning for moving the rack, use the delivery forms provided in Appendix A.

Figure 4: MCS 5042 shipping package delivery and maneuvering space requirements for a single IT rack configuration

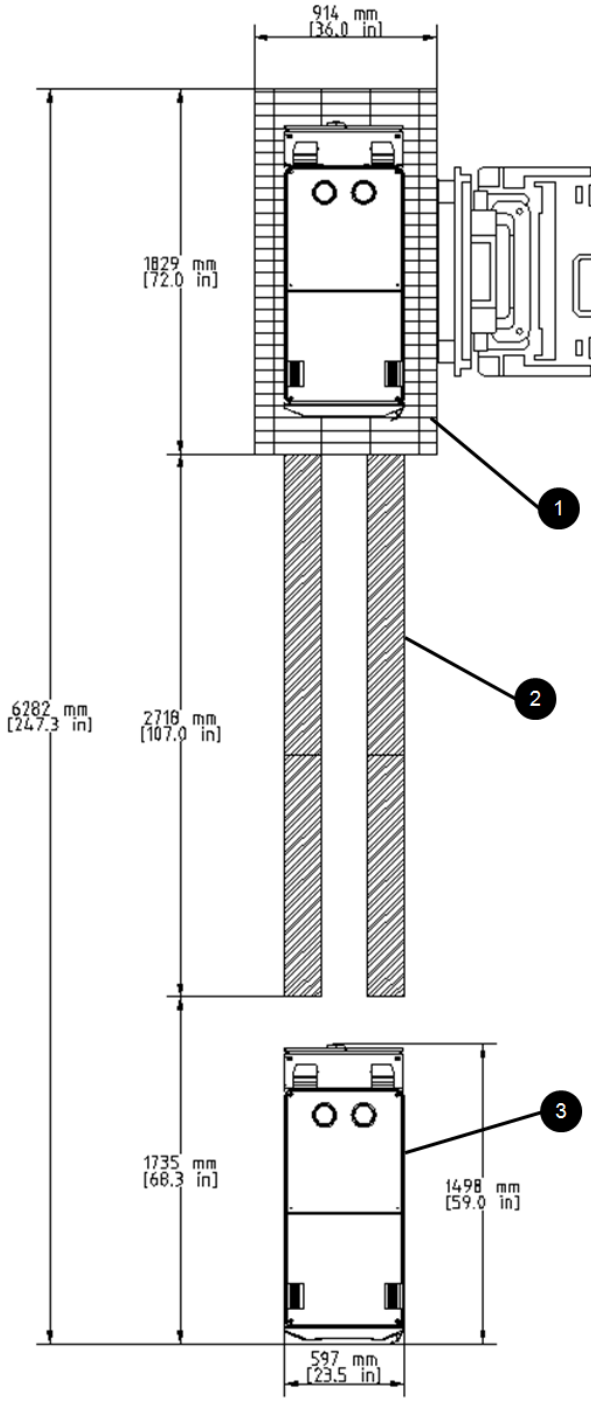


Item	Reference
1	MCS 5042 shock-pallet
2	3 piece ramp
3	HP mc-Series 5042 Rack

Caution:
HP recommends that a ramp angle of no greater than 5° be used to move the MCS 5042 up or down elevations. Typical data center ramps have a 5° angle (1 to 12 pitches).

Figure 5 shows the maneuvering space required when unloading the HP MCS 5042 Expansion Rack Kit (BW973A, available on the HP website at http://www.hp.com) from a pallet. When planning for moving the rack, use the delivery forms provided in Appendix A.

Figure 5: MCS 5042 shipping package delivery and maneuvering space requirements for the HP MCS 5042 Expansion Rack

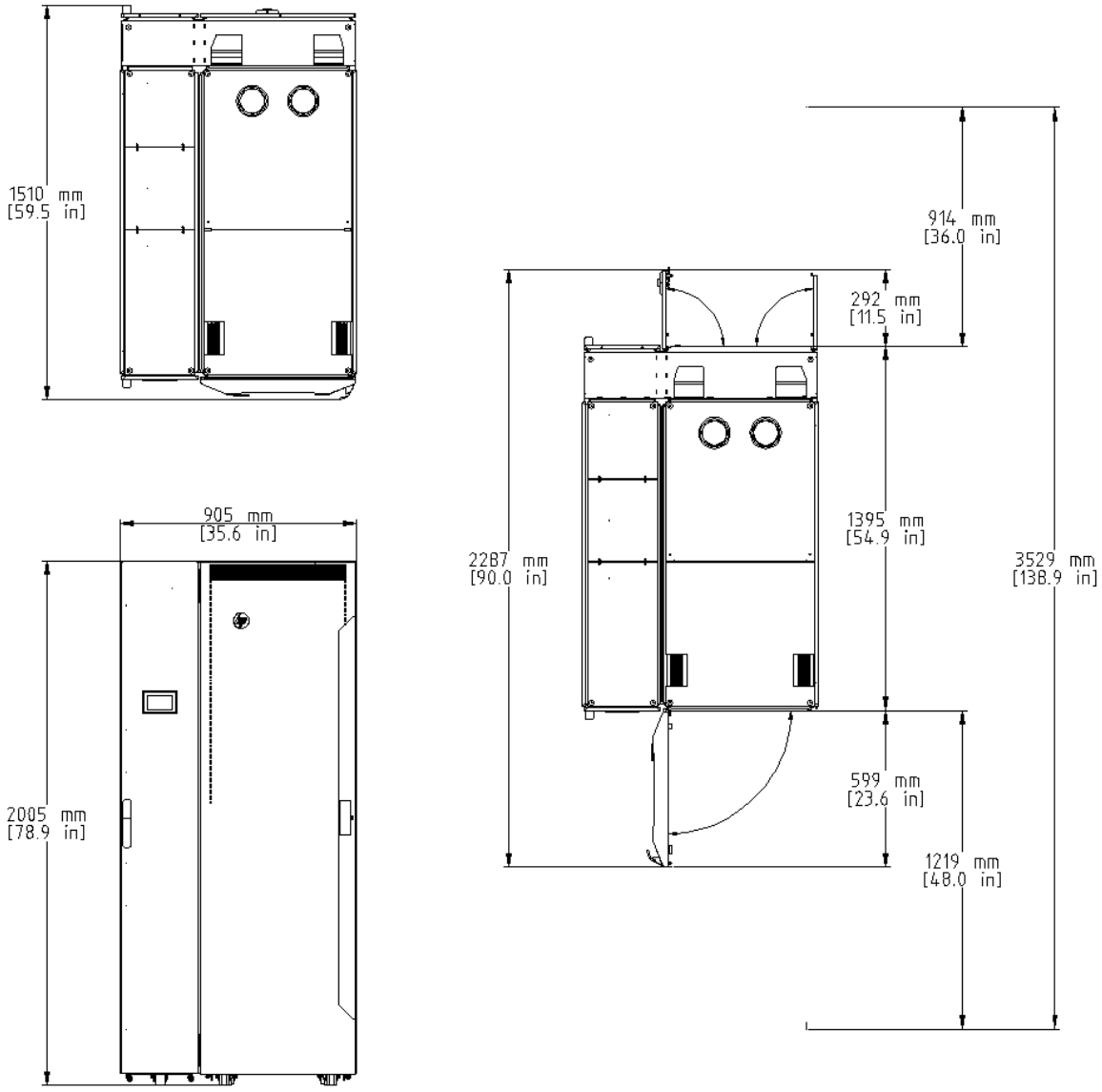


Item	Reference
1	MCS 5042 shock-pallet
2	4 piece ramp
3	HP mc-Series 5042 Expansion Rack

Operational space requirements

To provide space for internal airflow and housing of the cooling unit components, the MCS 5042 is wider and deeper than conventional HP racks. HP recommends a minimum access space for the MCS 5042 in the standard single rack configuration be 1219 mm (4 feet) in the front and 914mm (3 feet) in the rear as shown in Figure 6.

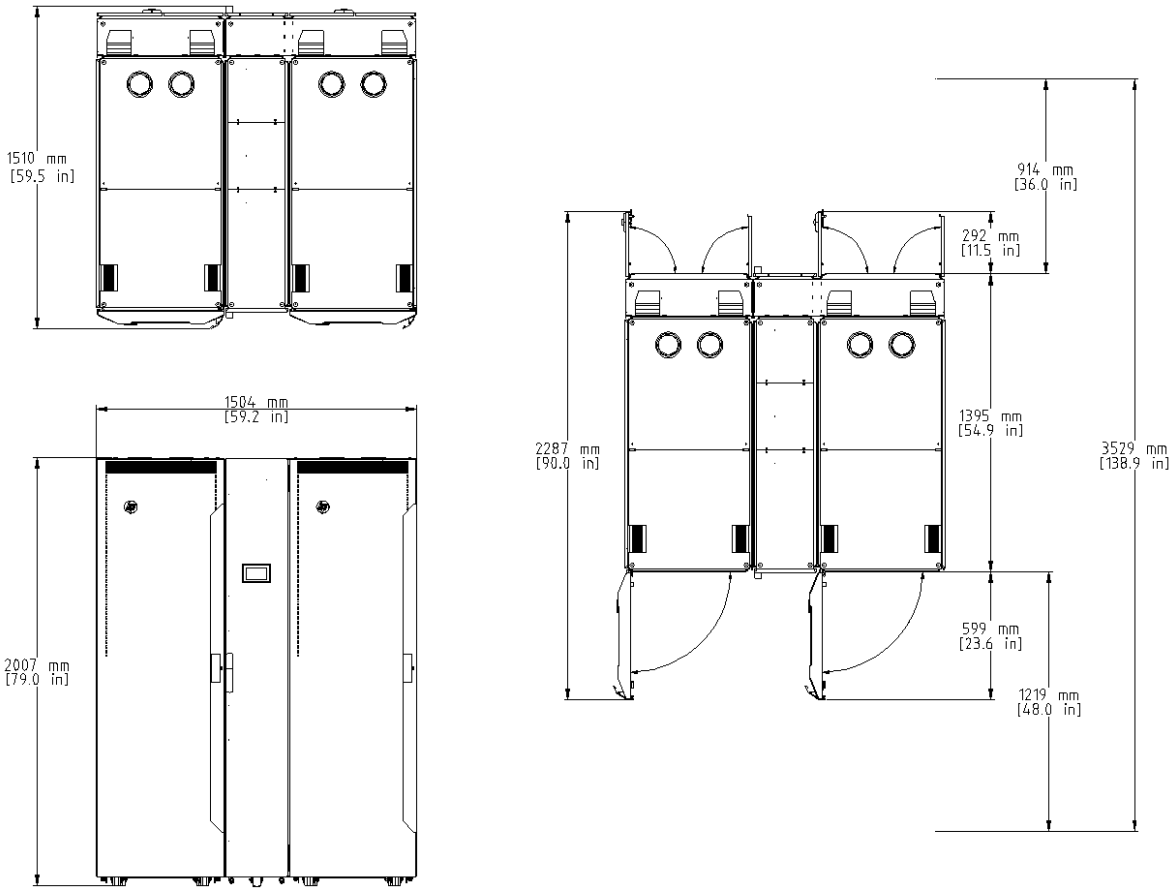
Figure 6: MCS 5042 operational space dimensions



Note:
With the top shipping bracket the total height is 2069mm (81.5 inches).

An HP MCS 5042 installed in a dual rack configuration requires approximately an additional 600 mm of width space to accommodate the second IT rack mounted to the left of the cooling unit, as shown in Figure 7.

Figure 7: MCS 5042 operational space dimensions in a dual-rack configuration

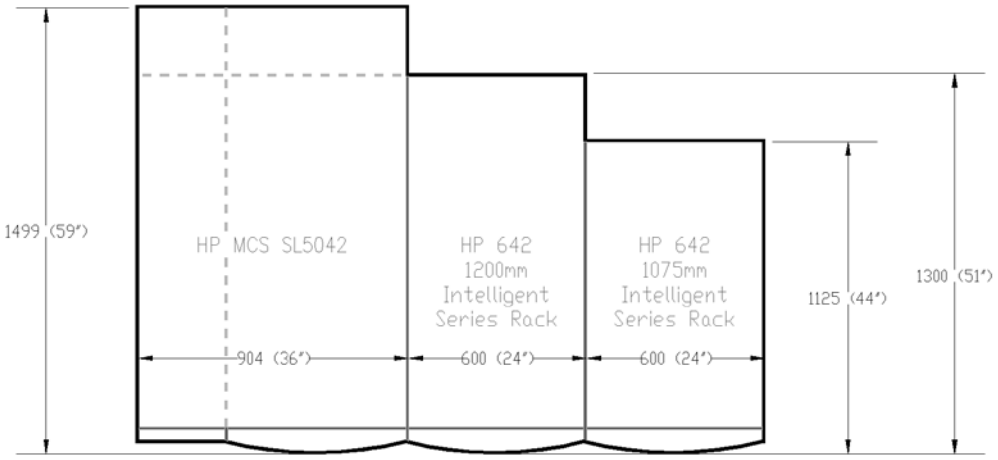


System positioning

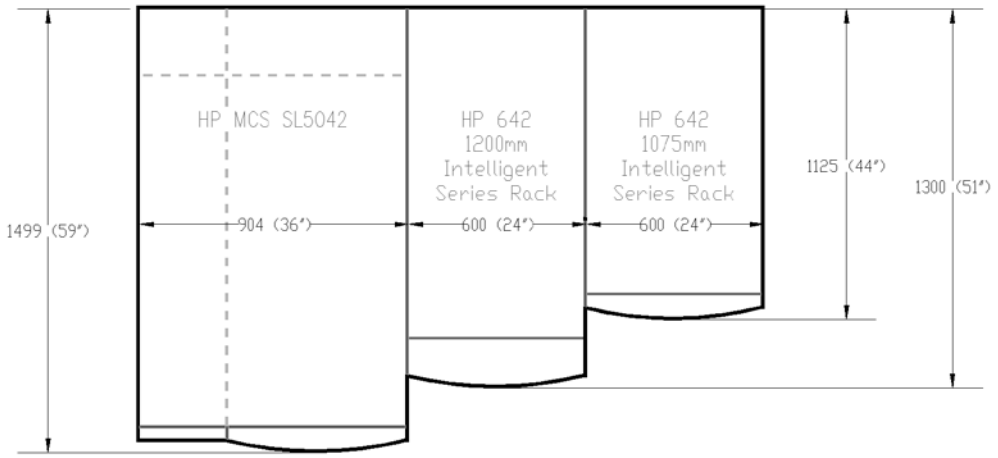
The MCS 5042 can be installed next to an existing or new row of HP Intelligent Series racks. Based on facility design requirements, the cabinets can be arranged in a flush front (Figure 8A) or flush rear (Figure 8B) configuration.

Figure 8: MCS 5042 arranged in a flush front configuration with a HP Intelligent Series rack row

8A: Flush front configuration



8B: Flush rear configuration



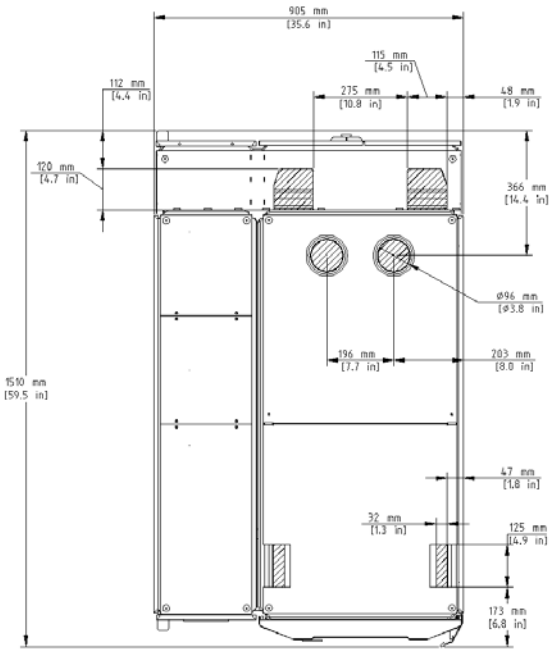
Note:
When arranging the MCS 5042 immediately next to a HP Intelligent Series rack, front or rear door swing might interfere, depending on the configuration. Equipment might require the removal of a door for full, unimpeded access.

Cable openings

The MCS 5042 system has several useable cable openings at front top, rear bottom and rear top of the IT rack. Figure 9A shows the size and position of the cable openings at the top and Figure 9B shows the cable openings at the bottom in the standard single-rack configuration.

Figure 9: MCS 5042 cable openings in a single rack configuration

9A: Top view



9B: Bottom view

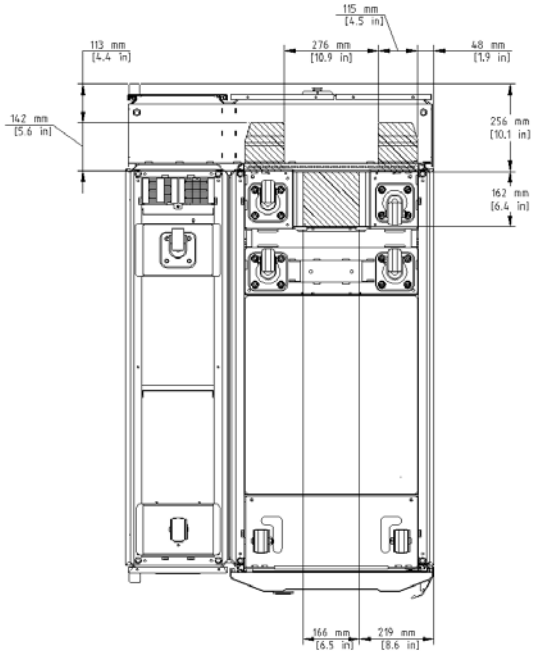
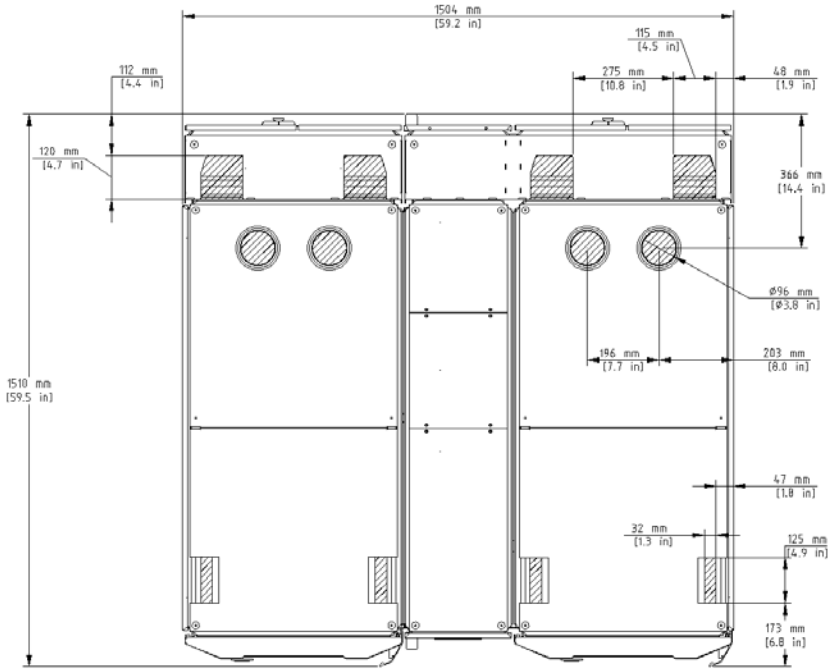


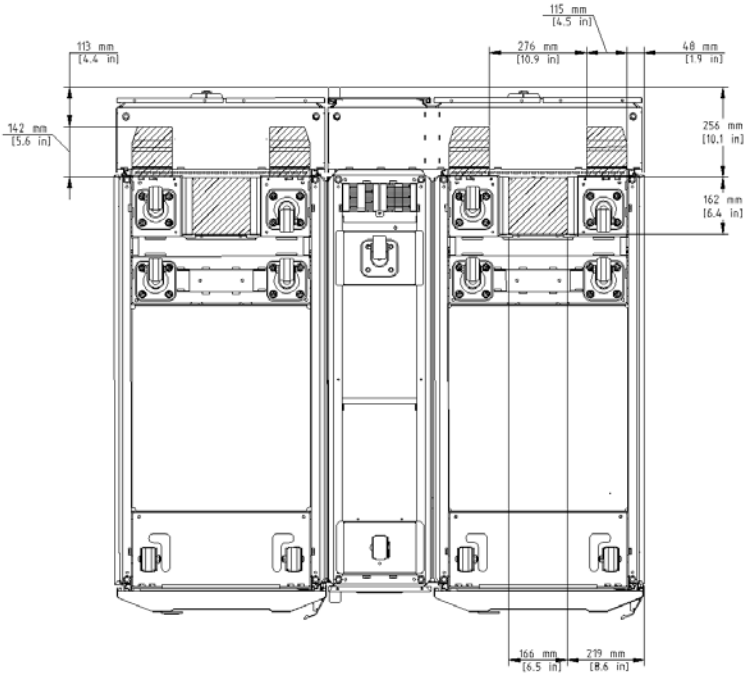
Figure 10 shows the size and position of the cable openings in a dual-rack configuration at the top and at the bottom.

Figure 10: MCS 5042 cable openings in a dual rack configuration

10A: Top view



10B: Bottom view



Cabinet leveling feet

The MCS 5042 system includes leveling feet and does not require fastening to the floor. To ensure the enclosure remains stable during operation and servicing and to avoid personnel and equipment damage, take care when the loading of the equipment.

Warning:
Static loading limits cannot be achieved if the rack is not on its leveling feet, and rolled or pushed from its position.
Your floor weight capacity might not support the full static load capacity. Check with your floor provider before loading. HP is not responsible for floor damages due to floor overloading.

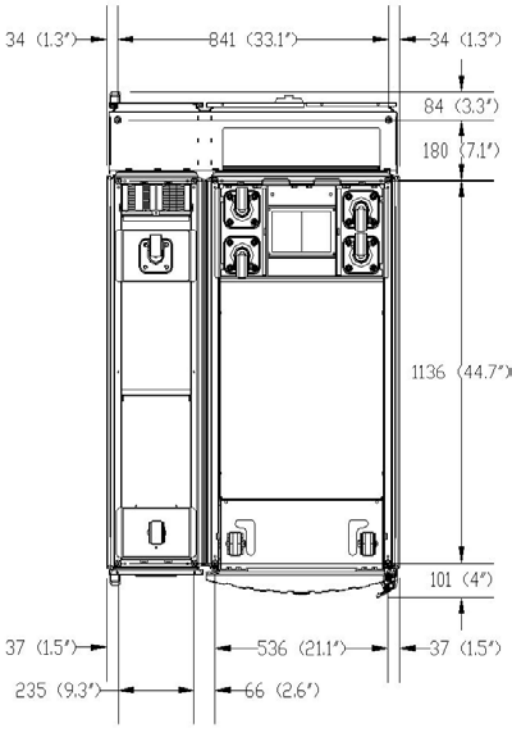
Note:
The IT rack of the MCS 5042 unit supports 1360 kg (3000 lb) of static loads of IT equipment on the leveling feet.

Figures 11A and 12A show the locations of the cabinet leveling feet, and figures 11B and 12B show an example of the locations on the raised floor. Ensure there is adequate floor and supporting understructure remaining to support the load-bearing leveling feet, especially immediately around the cutout. After the MCS 5042 is positioned in the proper location in the data center, the leveling feet can be lowered into place to level and stabilize the MCS 5042.

Caution:
To reduce the risk of damage to the casters, make sure that the full weight of the rack rests on the leveling feet, and not on the casters. The casters are designed only as an aid in moving the rack into position. They are not designed to support the weight of the rack, and the caster might become damaged if relied on to support the rack.

Figure 11: Cabinet leveling feet locations in a single-rack configuration

11A: Bottom view



11B: IT rack-side view

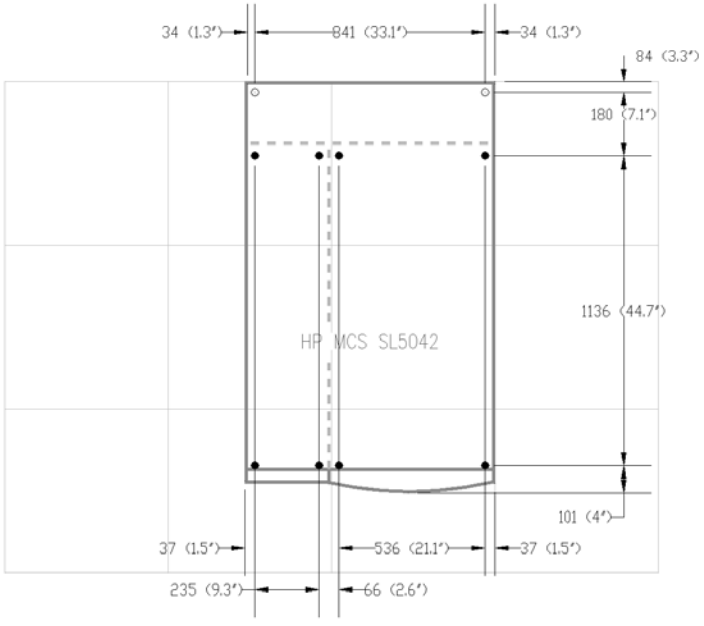
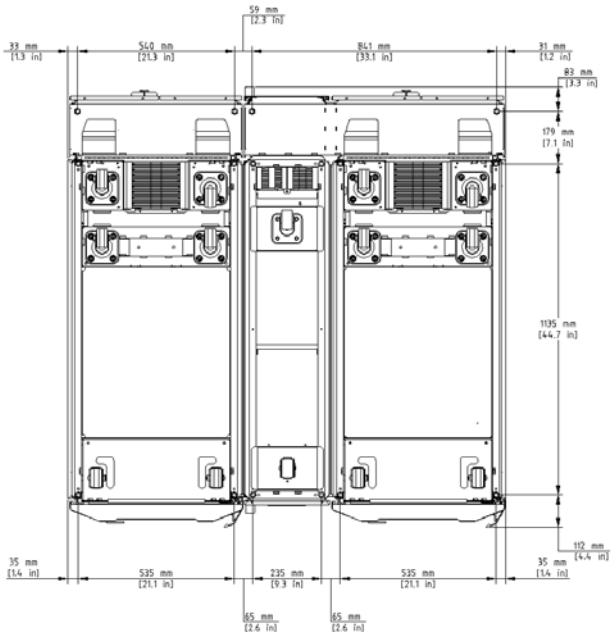
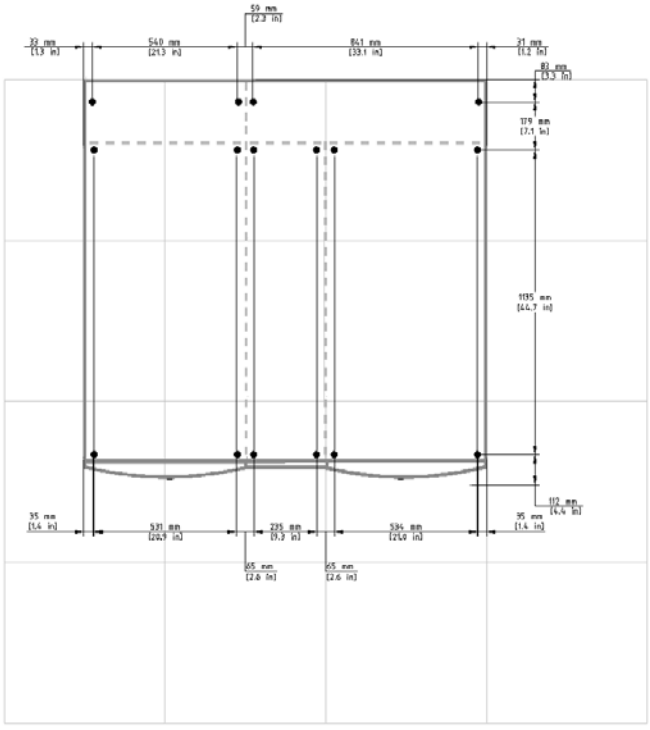


Figure 12: Cabinet leveling feet locations in a dual rack configuration

12A: Bottom view



12B: Right IT rack-side view



Floor loading considerations

The computer room floor must be able to support the total weight of the installed servers as well as the weight of the MCS 5042 as they are moved into position. The information presented in this section is applicable to raised floor installations.

Warning:
HP cannot assume responsibility for determining the suitability of a particular raised floor system. The customer or local agencies must determine installation requirements. An appropriate structural engineer must verify any floor system under consideration for a server installation.

Raised floor loading is a function of the floor manufacturer's load specification and the positioning of the equipment relative to the raised floor grid. HP recommends the following guidelines:

- Some raised floor systems do not have grid stringers between floor stands. The lateral support for the floor stands depends on adjacent panels being in place. To avoid compromising this type of floor system while gaining under-floor access, remove only one floor panel at a time.
- Larger floor grids (bigger panels) are generally rated for lighter loads.

Table 3 can be used to calculate the weight load of each MCS 5042 unit, including installed equipment for proper floor planning. The text in blue is included as an example. Weights can vary.

Table 3: MCS 5042 weight calculation

Component	Unit weight	Qty. (Multiply by)	Total weight
MCS 5042 (with unpopulated server rack)	450 kg (992 lb)	1	450 kg (992 lb)
Component #1: HP ProLiant S6500 SL230s	91 kg (200 lb)	8	728 kg (1,600 lb)
Component #2:			
Component #3:			
Component #4:			
Rack total:			

Note:
The MCS 5042 has not been certified for seismic environments.

Table 4: Common floor loading terms

Term	Description
Dead load	The weight of the raised panel floor system, including the understructure. Expressed in lb/ft^2 (kg/m^2).
Design load	The safe load that a floor panel can support on a 1 inch x 1-inch^2 (25 mm x 25 mm^2) area at the panels weakest point (typically the center of the panel). This value is determined by taking the lesser value of the maximum load that can be applied without failure divided by a safety factor of two (ultimate load) or the load at which permanent damage begins to occur (yield point).
Rolling load	The load a floor panel can support (without failure) when a wheel of specified diameter and width is rolled across the panel.

Note:
If the specific floor being evaluated or considered is a product other than a Tate All Steel 1250 System floor, you must contact the manufacturer of the floor to evaluate if it meets the requirements described in this section.

Table 5: Tate All Steel 1250 raised floor specifications

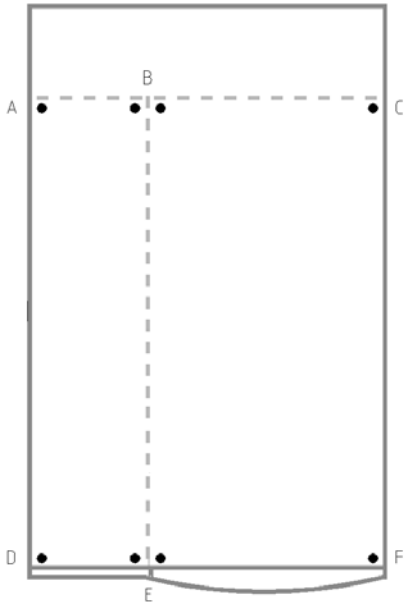
Item	Rating
Dead load	34.2 kg/m^2 (7 lb/ft^2)
Design load [1]	567 kg (1,250 lb)
Rolling load	227 kg (500 lb)

[1] Similar to concentrated load

Note:
The IT rack of the MCS 5042 can carry a static load of up to 1,360 kg (3,000 lb).

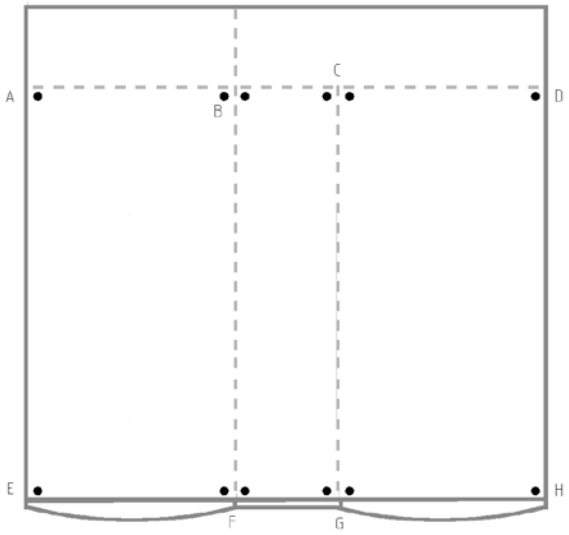
Note:
In Figures 13 and 14, the load is in the center of the IT racks. Due to adjacency, the leveling feet in points B and E in Figure 13 and points B, C, F, and G in Figure 14 are combined to one concentrated weight.

Figure 13: Weight distribution on the leveling feet locations in a single rack configuration



	Weight
A	79 kg (174 lb)
B	458 kg (1010 lb)
C	385 kg (349 lb)
D	83 kg (183 lb)
E	457 kg (1008 lb)
F	375 kg (827 lb)

Figure 14: Weight distribution on the leveling feet locations in a dual rack configuration



	Weight
A	385 kg (849 lb)
B	455 kg (1003 lb)
C	458 kg (1010 lb)
D	385 kg (849 lb)
E	375 kg (827 lb)
F	457 kg (1007 lb)
G	457 kg (1007 lb)
H	375 kg (827 lb)

Caution:
To reduce the risk of damage to the casters, make sure that the full weight of the rack rests on the leveling fee, and not on the casters. The casters are designed only as an aid in moving the rack into position. They are not designed to support the weight of the rack, and the casters might become damaged if relied on to support the rack.

Electrical considerations

The MCS 5042 provides two Walther Procon A5 series AC input connections and ships with two sets of power cords for connecting to redundant AC power busses, if available. Only one power cord is necessary for operation. The second cord can be connected to a redundant AC power bus to improve system availability by protecting against power source failures or accidentally tripped circuit breakers.

Note:
Electrical practices and suggestions in this guide are based on North American practices. For regions and areas outside North America, local electrical codes take precedence over North American electrical codes. For example, HP recommends that the protective ground conductor be green with yellow stripes. This requirement is a North American directive and does not override the local code requirements for a region or areas outside North America.

Note:
The power requirements discussed in this guide are for the fans and electronics for the MCS 5042 only. Data processing components such as servers, storage, and network devices must be considered separately, based on individual power requirements.

System grounding

HP server systems require two methods of grounding: power distribution grounding for safety, and high-frequency signal grounding for equipment performance. Power distribution grounding involves the main building electrical service entrance, electrical conduit, facility power panels, and equipment cabinets (including the MCS 5042), which must be grounded, using green/yellow insulated wire conductors according to the applicable electrical codes. High-frequency grounding consists of using ground return conductors for intra-cabinet and inter-cabinet signal interconnects, as well as chassis and cabinet grounding.

For MCS 5042 and server systems installed on a raised floor, the floor assembly must be electrically grounded to form a complete ground grid. An optimum raised-floor grounding solution is shown in Figure 15.

Each floor panel must have at least one supporting pedestal grounded to the power panel and another pedestal grounded to the MCS 5042. The central ground connection of the MCS 5042 is located in the bottom rear of the IT rack. This broadband solution provides grounding for maximum safety and performance.

Figure 15: Central ground stud location inside the IT rack

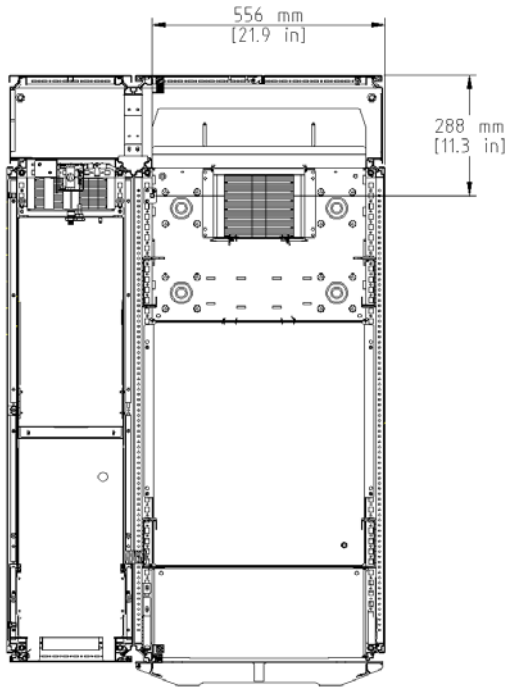
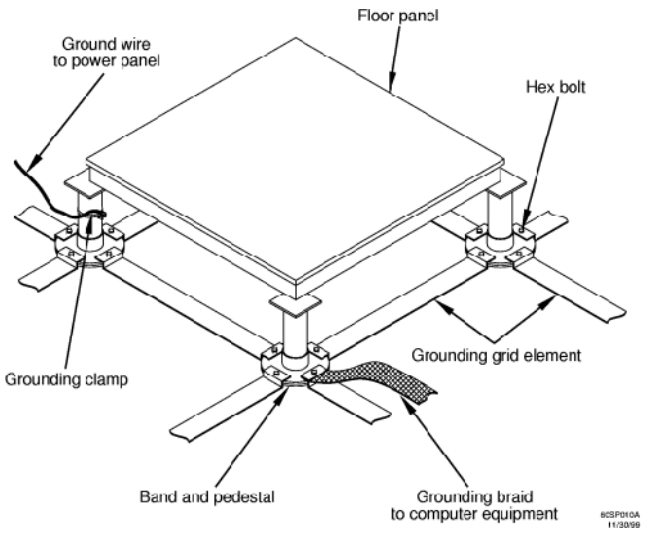


Figure 16: Raised floor grounding



Voltage fluctuations and outages

The MCS 5042 is designed to provide immunity to power outages of less than one cycle. However, testing cannot conclusively rule out loss of service. Therefore, adherence to the following guidelines provides the best possible performance of power distribution systems for HP equipment:

- Dedicated power source—Isolates the power distribution system from other circuits in the facility.
- Missing-phase and low-voltage detectors—Shuts equipment down automatically when a severe power disruption occurs. For peripheral equipment, these devices are recommended but optional.
- Online uninterruptible power supply (UPS)—Keeps input voltage to devices constant and must be considered if outages of one-half cycle or more are common. For more information, consult a qualified contractor or consultant, as necessary.

The MCS 5042 can be protected from the sources of many electrical disturbances by using:

- An isolated power distribution system
- Power conditioning equipment
- Over-voltage and under-voltage detection and protection circuits
- Shielding to attenuate higher frequency radiated electrical energy
- Surge protective devices on power cables to protect equipment against electrical storms

Electrical planning around water handling components

Because of the potential of forming condensate on non-insulated water connections or leaking water connections around water-based cooling systems, a few issues must be considered during the electrical planning:

- Water-proofed connectors
- Watertight conduits for cables
- Leak detection systems

Warning:
If water comes in contact with power cables, before cleaning up water in this area, shut down the main breaker.

To identify water-proofed connectors, HP recommends looking at the IP-rating of the connector, based on the international standard IEC 60529. Additionally, HP recommends a connector that is at least rated IP 67.

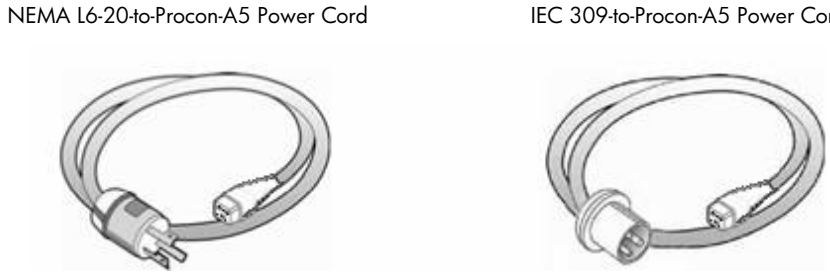
Cable conduits are available in different styles depending on flexibility and materials. The common materials are plastic, metal, nylon or mostly a composition of these materials. Watertight conduits are available in both ways flexible or hard material, depending on the application.

A leak detection system for data center usually uses leak sensor cables, which are installed on the sub-floor in a raised floor and connected to a facility management system.

Connecting to facility AC power

The MCS 5042 accepts AC power through two Walther Procon A5 series power receptacles located at the top rear patch panel. The MCS 5042 ships with two sets of AC power cords for connecting to redundant AC power busses, if available. Figure 17 shows the two types of power cords that ship with the MCS 5042. The NEMA L6-20 power cord uses a NEMA L6-20 male plug for connecting to a facility AC feed connector common to North America and Japan. The IEC 309 power cord uses an IEC 309 male plug for connecting to a facility AC feed connector common in various international regions.

Figure 17: MCS 5042 power cords

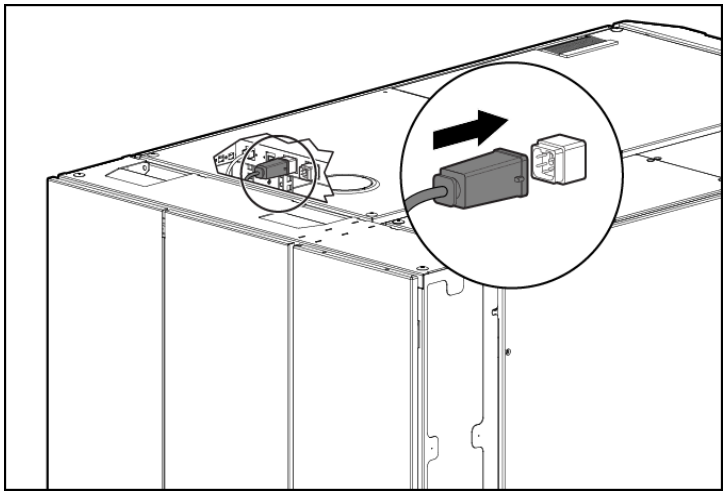


At least one power cord must be used for operation of the MCS 5042. To improve system availability, the second cord can be connected to a redundant AC power bus. When the redundant power is connected, the transfer switch assembly of the MCS 5042 provides switch-over to the active power bus in the event of power source failures or accidentally tripped circuit breakers.

Note:
The power cords of the MCS 5042 are 4 m (13.1 feet) long. After the cords are connected to the MCS 5042 and routed down the rear of the IT rack, approximately 2 m (6.6 feet) will be left to connect to the power source.

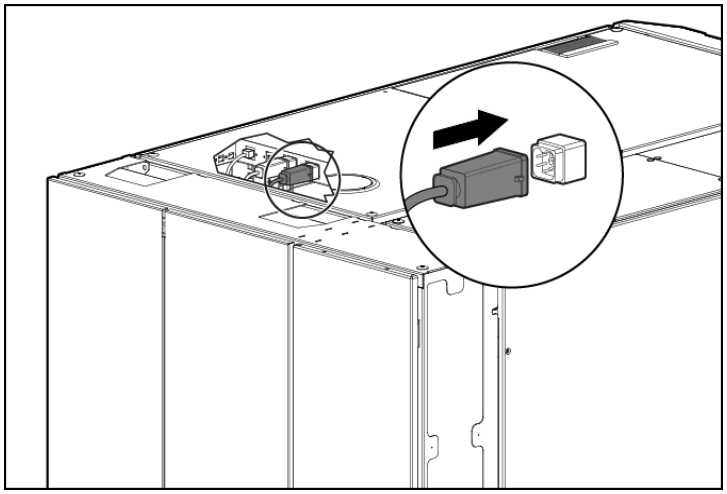
When using only a single (primary) source for power, the AC power cord is connected to the left-most receptacle (when viewed from the rear of the cabinet, labeled as AC1) as shown in Figure 18.

Figure 18: Single-source AC power connection



When redundant AC power is available, the redundant AC power cord is connected to the right receptacle (labeled as AC2) as shown in Figure 19.

Figure 19: Redundant-source AC power connection



Coolant source planning

A number of factors relating to a chilled water distribution system must be considered during the site preparation process, including the following:

- Redundant water configurations (For more information, see Appendix B.)
- Type of water source (shared water or dedicated chilled water loop)
- Maximum and minimum temperatures of building chilled water plant, and target chilled water temperature of dedicated loop based on total cooling capacity required and planned
- Viscosity of the chilled liquid, combined with the length and elevation changes in piping, determined by selected route, which can affect the selection of pipe size

Caution:
The minerals and chemicals typically found in tap water can react with metallic elements used in the MCS 5042. Electro-chemical reaction might cause scaling, corrosion, leaks, and blockage, ultimately resulting in reduced efficiency of the cooling system and even damage.

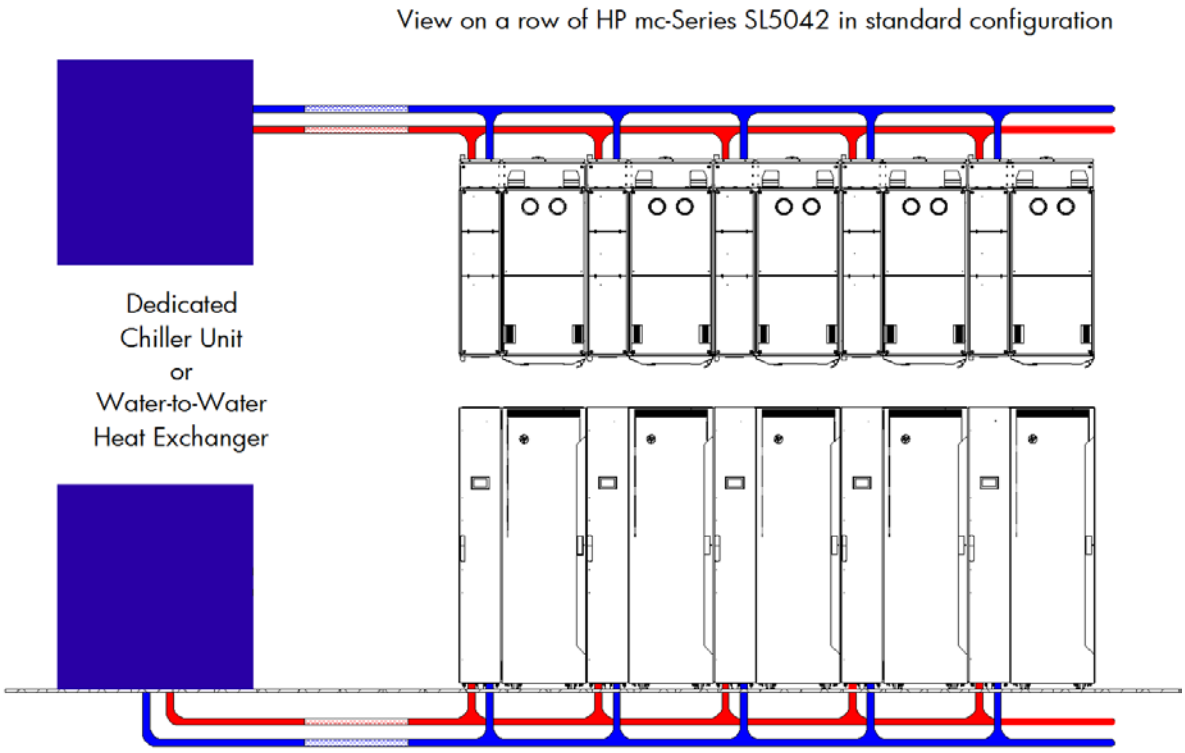
HP recommends that the water source for the MCS 5042 be a dedicated chiller unit or water-to-water heat exchanger that enables line isolation, better control of individual systems, and regulated water quality. The chilled water source for this loop is provided by one or more chiller systems. Advantages of using a dedicated loop include:

- Easier scheduling of maintenance to either a building system or dedicated MCS 5042 loop
- Easier maintenance of water quality parameters in the dedicated closed loop
- Better temperature and flow regulation to guarantee the needs of the MCS 5042
- More flexibility to regulate water temperature in order to reduce the potential for condensation

The use of building chilled water for the MCS 5042 unit is possible under certain conditions. However, consult with a qualified facilities design expert to determine whether this approach is possible within your specific data center. Refer to the requirements for water quality, temperature, and flow rate described in this section. Regardless of chilled water service approach, consult with a qualified facilities design expert to analyze new and existing systems and specify new work to insure water quality, temperature and water flow requirements can be met. The new work must meet all local safety and building code requirements as well as the customer's facility quality standards. Piping drawings and schematics included here are diagrammatic to convey a conceptual understanding of the MCS 5042 connection requirements.

Figure 20 illustrates the MCS 5042 being supplied directly by a dedicated chiller unit or water-to-water heat exchanger in a closed loop configuration.

Figure 20: Dedicated chiller unit directly supplying the MCS 5042



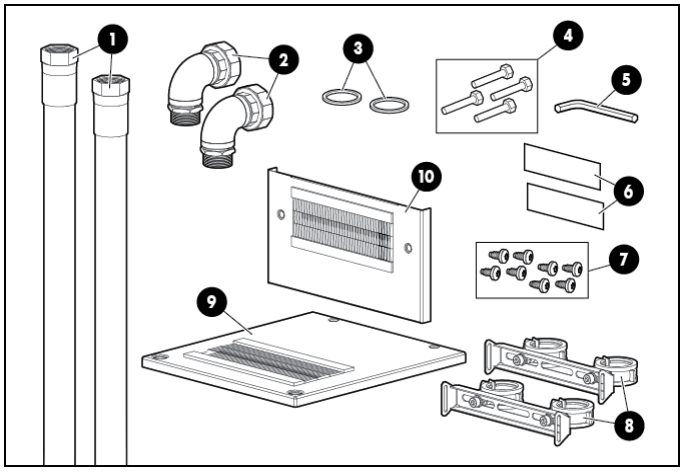
Plumbing considerations

A number of plumbing factors must be considered when installing the MCS 5042:

- (Highly recommended) Installing water shut off valves to enable infrastructure system flushing for the inlet and outlet of each MCS 5042
- Flow rate and pressure capacity of chilled water plant input to the design of the facility feed line and dedicated water loop pipe diameters
- Material compatibility within piping system to minimize the potential for electrochemical corrosion and must be corrosion-resistant
- Minimization of elbows and other restrictions that increase flow resistance
- Insulation of piping to minimize risk of condensation and reduce incidental heating of supplied chilled water
- Availability of a floor drain or reclamation system to capture system condensation
- Structural securing of piping to support weight of distribution network filled with water
- Water quality management, including particulate filtration, treatment, and flushing provisions, with isolation valves for service requirements
- Availability and access to a data center leak detection system to monitor the infrastructure system for leaks
- Air vents installed at the highest point in the pipe system (Each MCS 5042 has an air vent, but additional vents in the supply piping system must be considered.)

HP recommends the HP mc-Series 5042 Rack Water Hook-up Option Kit BW971A (available on the HP website at http://www.hp.com) for connecting the MCS 5042 to a facility chilled water system. Each kit (Figure 21) includes the hoses and accessories required for connecting the facility supply and return lines to the main inlet and outlet connections of an MCS 5042 unit and must be installed prior to the delivery of an MCS 5042.

Figure 21: MCS 5042 Water Hook-Up Option Kit contents



Item	Description (Quantity)
1	Main hose assembly* (2)
2	90-degree elbow assembly (2)
3	Viton gasket (2)
4	M6 screw (4)
5	5mm Hex L-key (1)
6	Warning label (2)
7	M5.5 x 10 self tapping screw (8)
8	Hose mounting brackets with hose clamps (2)
9	Top cover plate (1)
10	Rear cover plate (1)

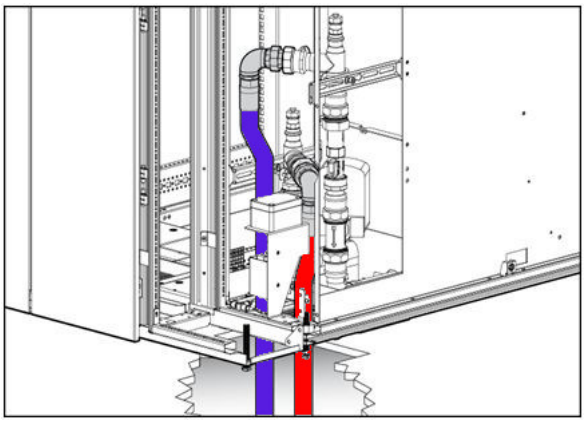
* Not drawn to scale. The actual length of the main hose is approximately 3.5 m (11.5 ft).

Caution:
You must properly connect the cabinet and facility cool water inlet and warm water outlet hoses. The MCS 5042 does include a check valve to prevent the reverse flow of coolant.

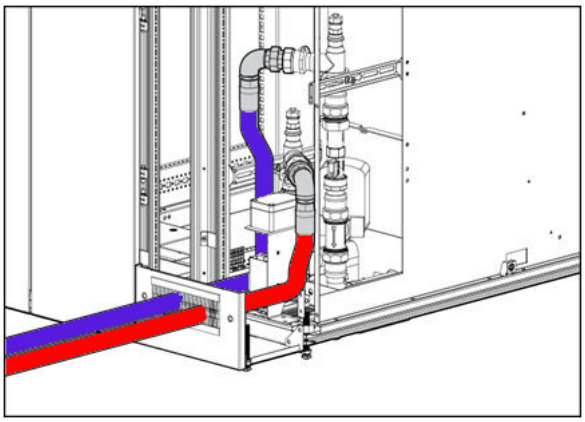
The MCS 5042 has the connecting fittings inside the unit, approximately 600 mm (24 inches) above the floor on the rear side. It allows the main coolant hoses to be routed either down through the cutouts in a raised floor (HP recommended) or up through openings in the top of the cabinet and above the unit or through the back of the cabinet and above the floor as shown in Figure 22. The left (blue) hose designates the chilled water supplied to the MCS 5042 and the right (red) hose is the warm water exiting from the MCS 5042.

Figure 22: Main coolant line hookup options for the MCS 5042

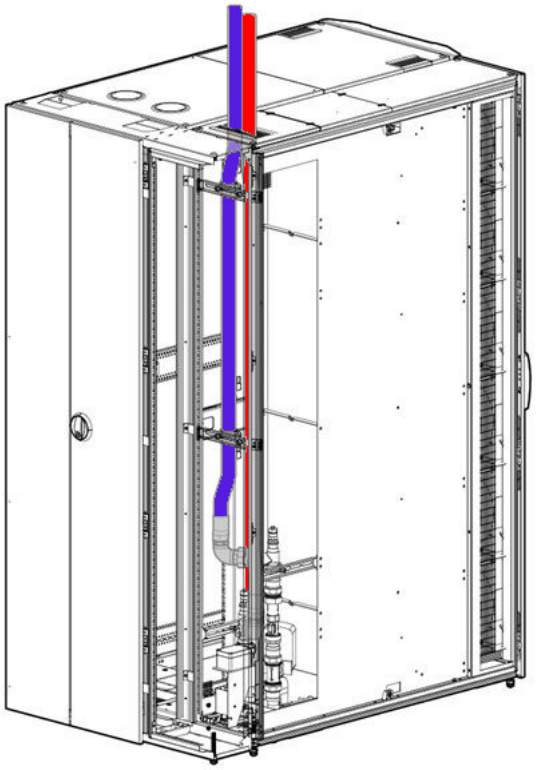
A: Through raised floor cutouts



B: Above the floor



C: Above the unit



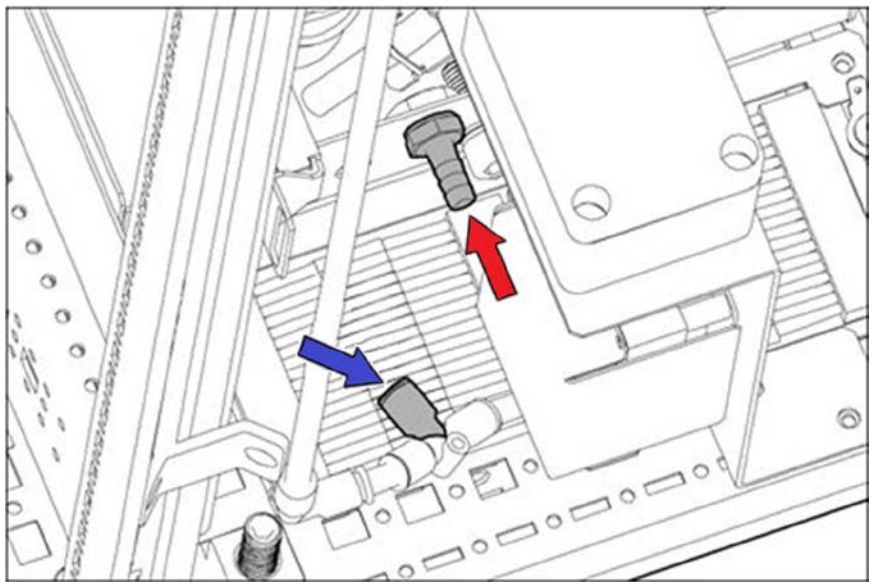
An HP Water Hook Up Kit must be installed prior to activating an MCS 5042. The length is approximately 350 cm (138 inches) of flexible hose terminated with fittings at each end. The length that is available outside the MCS 5042 depends on the type of connection that is desired as shown in Figure 22.

Table 6: Available hose lengths outside the MCS 5042 by connection type

Connection type	Approximate length supply hose	Approximate length return hose
Bottom	280 cm (110 inches)	300 cm (118 inches)
Rear	280 cm (110 inches)	300 cm (118 inches)
Top	200 cm (79 inches)	180 cm (71 inches)

Figure 23 shows the location of the condensate (blue) and overflow (red) in the rear of the cooling unit. The MCS 5042 includes both tubes for the hook up. Each tube is approximately 3 m (9 feet) in length. The overflow hose has an inner diameter of 9 mm (0.35 in) and the condensation hose has an outer diameter of 8 mm (0.31 in). The preferred method of routing for all hoses is downward at an angle of at least 3° (pitch of 0.6 inches per 12 inches), without loops, and away from the MCS 5042 cabinet. Pumped condensation and gravity-fed overflow hoses must be routed to a floor drain or reclaim system.

Figure 23: MCS 5042 condensation and overflow hook up



Note:
Flexible attachment hoses are intended to allow for deflection in any direction for equipment mounted on dynamic platforms, or for slight relocation of cabinets.

Note:
Installation service for this MCS 5042 is order number UE005E.

Piping approaches

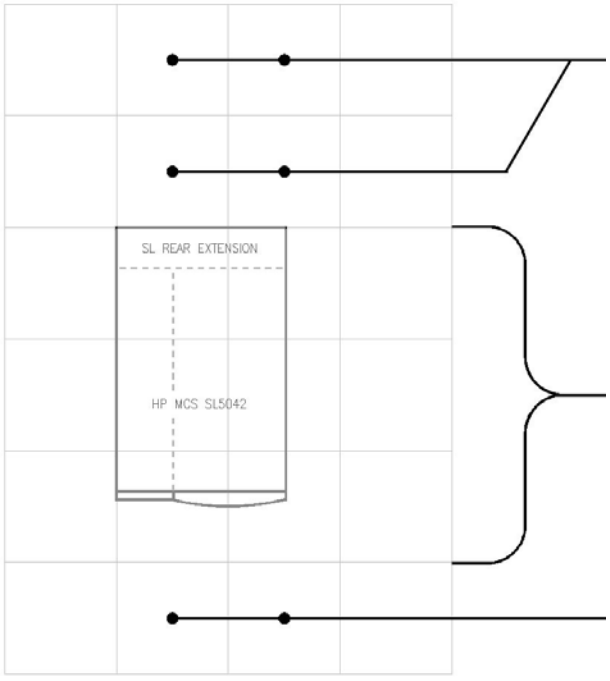
HP recommends the following methods for facility plumbing orientation with the MCS 5042:

- Direct rear approach
- Left rear approach
- Right rear approach

Note:
You can approach the MCS 5042 from the front with piping for the top and bottom connection. However, this approach requires careful planning for accessible component locations and hose attachments.

Figure 24 shows the recommended facility piping approaches to the MCS 5042.

Figure 24: Piping locations for the MCS 5042



Preferred piping location
Locate chilled water piping taps behind the MCS 5042 either under the floor or above the floor. The chilled water taps must approach laterally.

Do not locate piping connections or components under the MCS 5042

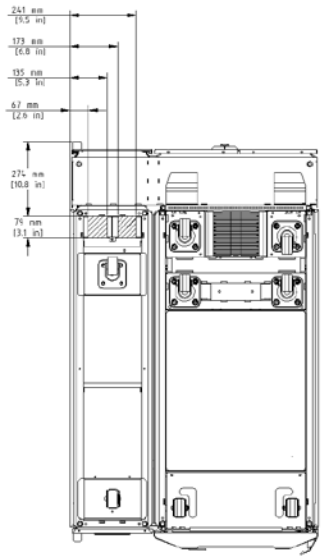
Alternate piping location
Locating chilled water piping taps in front of the MCS 5042 (under the floor) is possible. This option requires careful planning due to the chilled water hose length limitation.

MCS 5042 hose openings

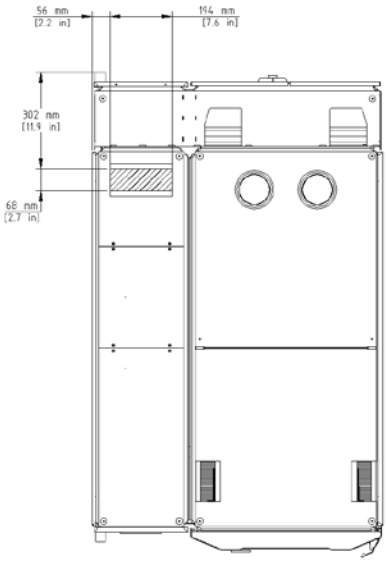
Figure 25 shows the dimensions and locations of the various hoses openings of the MCS 5042.

Figure 25: Hose openings for the MCS 5042

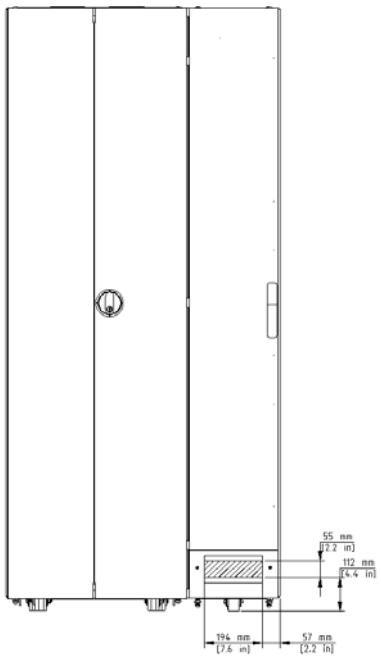
A: Bottom



B: Rear



C: Rear



Raised floor cutouts for MCS 5042

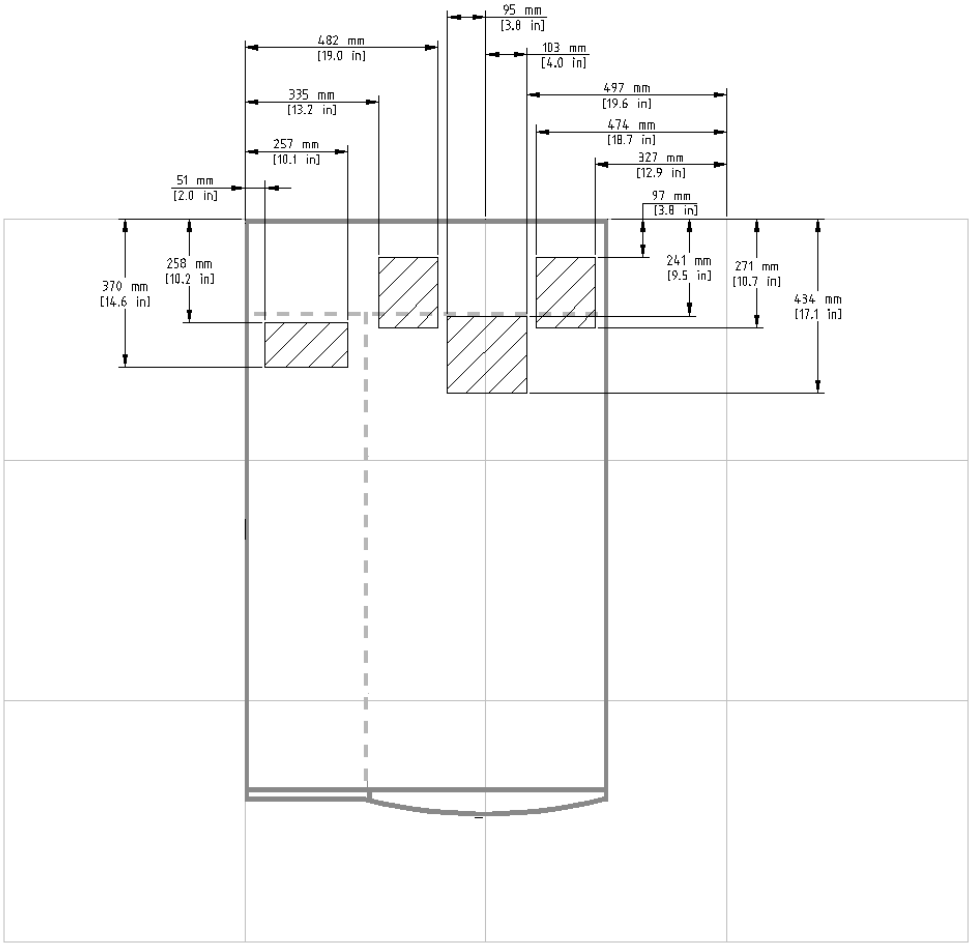
A complete MCS 5042 installation typically requires the following floor cutouts in a raised-floor facility:

Standard rack configuration:

- One floor cutout for the chilled water hoses, drain hoses of the cooling unit
- One floor cutout for the power cords and data cables of the computer equipment rack (including power supply to the MCS 5042). For details on the top openings, see the section Cable openings.

Raised floor panels vary in size globally, but all create virtual grid lines or seams where panels come together. These seams are ideal for positioning computer racks on the raised floor. Figures 26 through 30 reference the locations of rack attributes aligned with raised floor seams to provide critical dimensions for floor cutouts.

Figure 26: Recommended floor cutouts (single rack configuration)—Option 1 (MCS 5042 cooling unit side flush to tile)

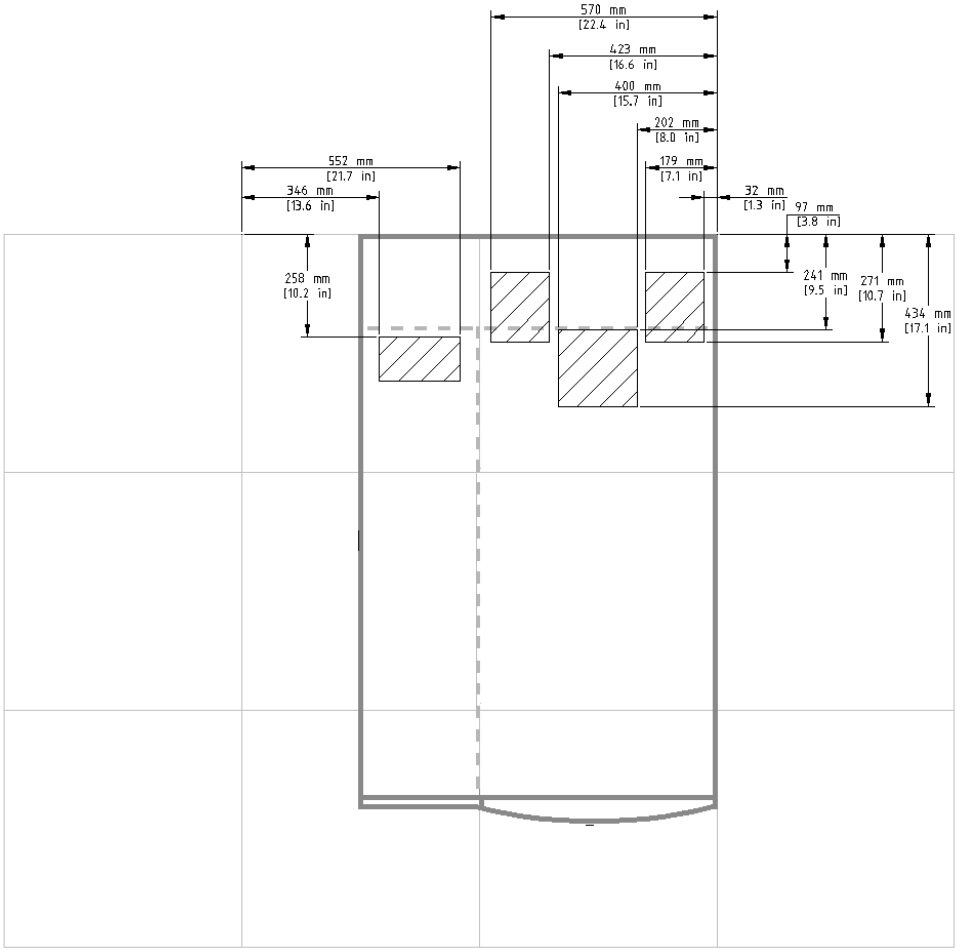


Note:
The wider opening in the back of the IT rack is optional.

Note:
The floor tile sizes used in Figure 26 are 600 mm x 600 mm (23.6 inches x 23.6 inches). Floor tile sizes vary.

Note:
The allowable tolerances are +/- 3.2 mm (+/- 0.125 inches). When installing multiple MCS 5042 units in a row, you must consider the tolerances as you plan the cutouts.

Figure 27: Recommended floor cutouts (single rack configuration)—Option 2 (MCS 5042 rack side flush to tile)

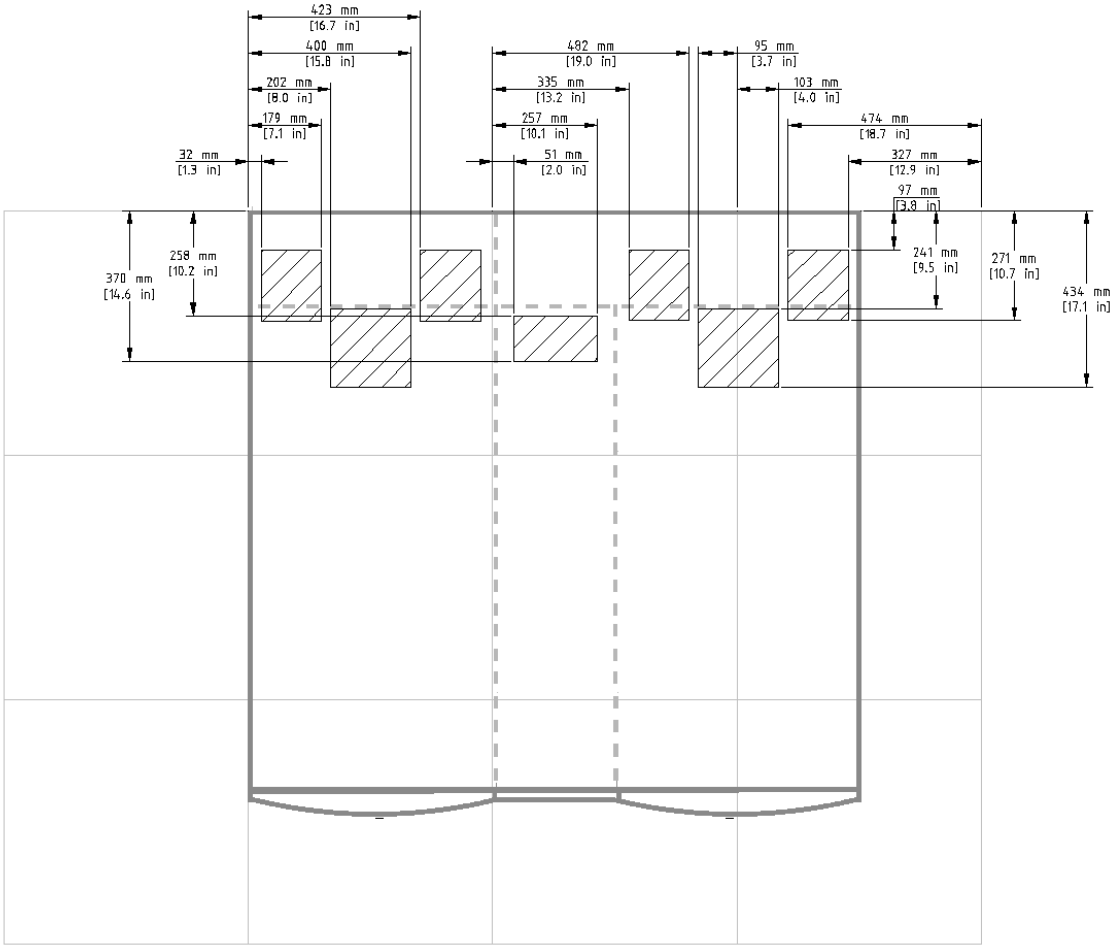


Note:
The wider opening in the back of the IT rack is optional.

Note:
The floor tile sizes used in Figure 27 are 600 mm x 600 mm (23.6 inches x 23.6 inches). Floor tile sizes vary.

Note:
The allowable tolerances are +/- 3.2 mm (+/- 0.125 inches). When installing multiple MCS 5042 units in a row, you must consider the tolerances as you plan the cutouts.

Figure 28: Recommended floor cutouts (dual rack configuration)—Option 1 (Left rack side flush to tile)

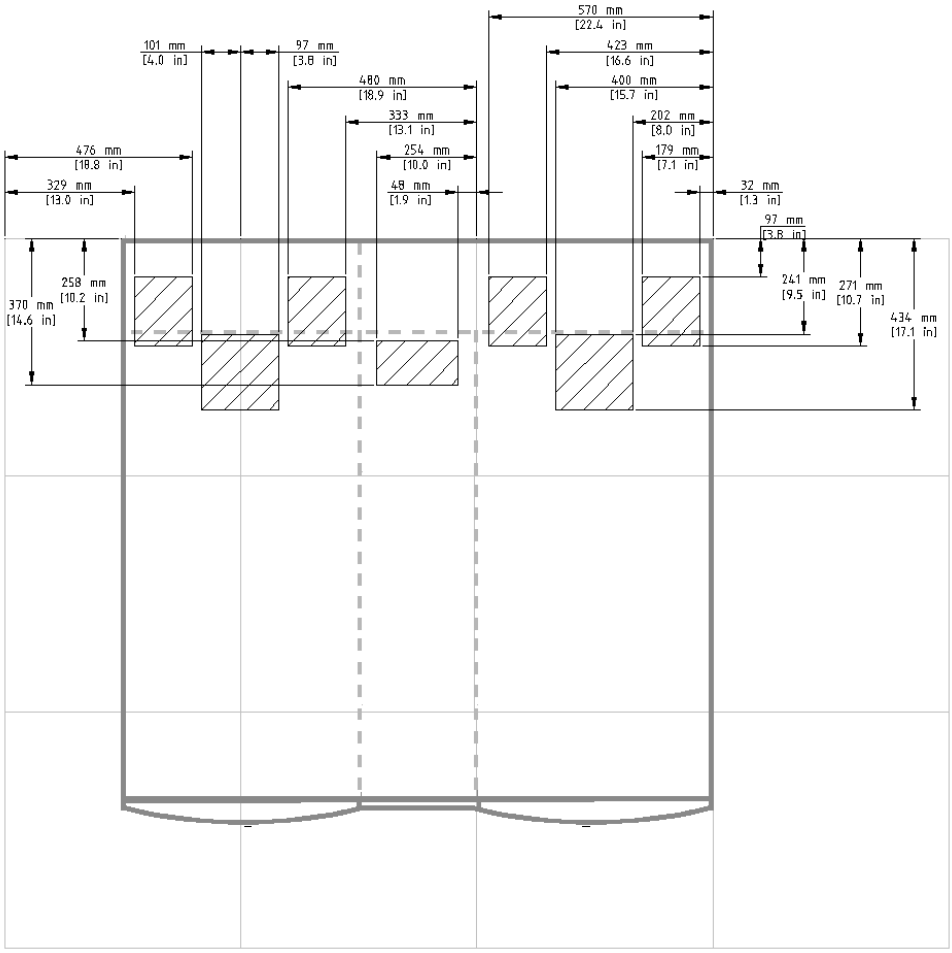


Note:
The wider opening in the back of the IT rack is optional.

Note:
The floor tile sizes used in Figure 28 are 600 mm x 600 mm (23.6 inches x 23.6 inches). Floor tile sizes vary.

Note:
The allowable tolerances are +/- 3.2 mm (+/- 0.125 inches). When installing multiple MCS 5042 units in a row, you must consider the tolerances as you plan the cutouts.

Figure 29: Recommended floor cutouts (dual rack configuration)—Option 2 (Right rack side flush to tile)



Note:
The wider opening in the back of the IT rack is optional.

Note:
The floor tile sizes used in Figure 29 are 600 mm x 600 mm (23.6 inches x 23.6 inches). Floor tile sizes vary.

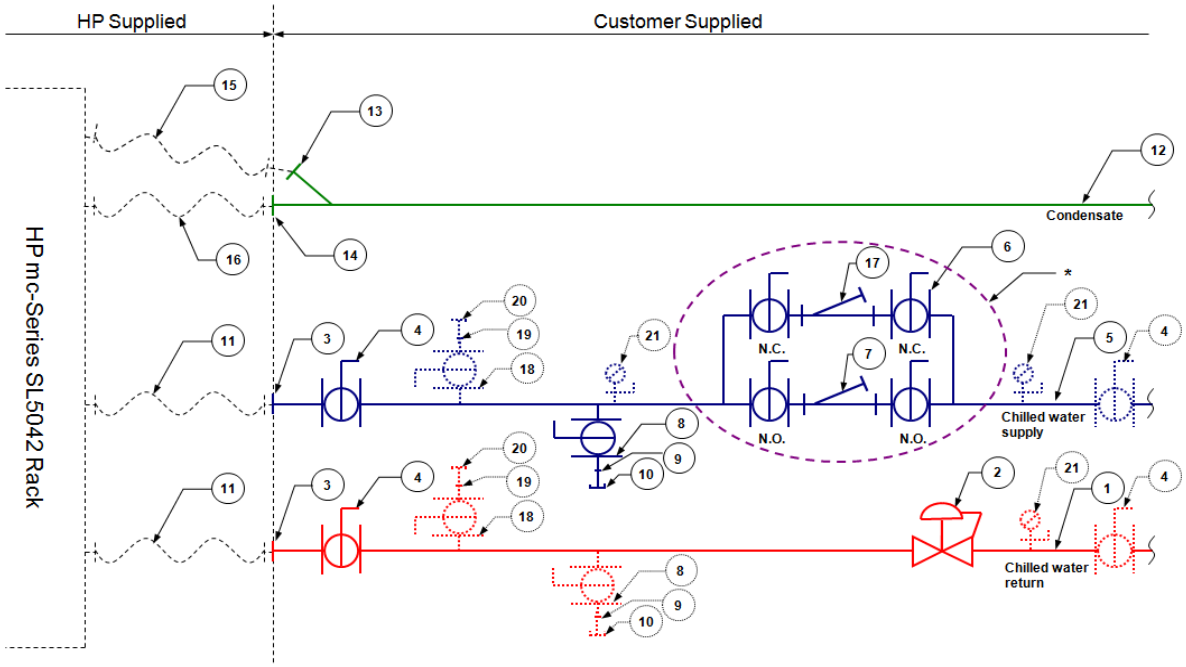
Note:
The allowable tolerances are +/- 3.2 mm (+/- 0.125 inches). When installing multiple MCS 5042 units in a row, you must consider the tolerances as you plan the cutouts.

Chilled water system components

The chilled water supply and return service to each MCS 5042 is required to have a particular combination of components for optimal performance. These components are identified in Figure 30 and described in Table 7.

Note:
Components in Figure 30 drawn with a solid line are strongly recommended. Components drawn with dot lines are advisable for a higher availability and serviceability.

Figure 30: Recommended plumbing configuration for the MCS 5042



* The 1 micron Filter may require a minimum of 30 in (762mm) clearance under the floor for installation. If the filter can not be installed under the floor due to space constraints, they may be located further upstream in the piping system.

Table 7: Typical plumbing components for a MCS SL4042 configuration

Item	Description	Specifications
1	Chilled water return line	Pipe:31.75 mm(1.25 inch), ASTM B 88, Type L, hard-drawn copper Fittings: ASTM B16.22 Wrought copper Solder: ASTM B 32, 95-5 Tin Antimony Thread Sealant: Seal and assemble according to local materials and practices
2	Flow/measurement balancing valve	Valve type: 31.75 mm (1.25 inch) bronze balancing valve, ball design, with positive shutoff, integral checked metering ports, adjustable knob, memory device, calibrated nameplate, integral drain port, and solder end connections Position: horizontal run of pipe. Note: Orient drain port toward MCS 5042. Avoid fittings closer to measurement valve than five (5) pipe diameters upstream and two (2) pipe diameters downstream for maximum performance. Watts® CSM-61 or equivalent, typical 1.
3	Pipe	31.75 mm (1.25 inch) copper, male (NPT or BSPP) adapter to connect the MCS 5042 water hoses, typical 2
4	Isolation valves	Valve type: 31.75 mm (1.25 inch) two-piece, full-port, brass ball valve, with chrome plated brass ball, PTFE seats, steel handle, with Female connections and 31.75 mm (1.25 inch) bushing on the end toward MCS 5042 hoses. Pressure rating: 600psi WOG, 150psi WSP. Watts® FBV-3C or equivalent.
5	Chilled water supply line	Pipe: 31.75 mm (1.25 inch), ASTM B 88, Type L, hard-drawn copper Fittings: ASTM B16.22 Wrought copper Solder: ASTM B 32, 95-5 Tin Antimony Thread Sealant: Seal and assemble according to local materials and practices
6	Strainer isolation valves	Valve type: 31.75 mm (1.25 inch) two-piece, full-port, brass ball valve, with chrome plated brass ball, PTFE seats, steel handle, with solder end connections. Pressure rating: 600psi WOG, 150psi WSP. Orientation: Stem vertical up for lateral level operation. Offset valves on CHWS and CHWR piping to prevent interference from lever actuators when closed. Watts® FBVS-3C or equivalent typical 4
7	Strainer	Type: 31.75 (1.25 inch) wye-patterned bronze strainer, with #30 stainless steel wire mesh liner, ¾-inch tapped retainer cap & gasket, and solder end connections. Provide 19.05 mm (0.75 inch) ball valve for blowdown with cap and chain. Pressure rating: 400 psi WOG, 125psi WSP. Orientation: with basket and blowdown valve directed down. Watts® S777 or equivalent
8	System drain valve	Type: 19.05 mm (0.75 inch) two-piece, full-port, brass ball valve with chrome plated brass ball, PTFE seats, and steel handle, with threaded connections. Pressure rating: 600psi WOG, 150psi WSP. Watts® FBV-3C or equivalent
9	Nipple	Type: 19.05 mm (0.75 inch) brass close nipple.
10	Cap	Type: 19.05 mm (0.75 inch) brass cap with chain.
11	Hose	Type: 1.25-inch flexible hose supplied with HP mc-Series 5042 Water Hook-up Kit.
12	Condensate line	Pipe: 19.05 mm (0.75 inch) copper or Schedule 40 PVC Fittings: Wrought Copper or Schedule 40 PVC Orientation: Sloping downward in a minimum angle of 1° (0.25 inch per 1 ft) and away from the MCS 5042 for gravity drain
13	Compression fitting	Type: 6.35 mm (0.25 inch) male NPT X 8 mm (0.31 inch) compression fitting, Parker

Item	Description	Specifications
		Hannifin, FBMB8-1/4 Metrulok fitting, Festo QB-1/4-5/16-U or equivalent and installed by plumbing contractor, typical 1.
14	Hose barb	Type: 12.7 mm (0.50 inch) I.D. hose barb x ¾-inch male NPT, Parker Hannifin, 125HBL-8-12, fitting or equivalent and installed by plumbing contractor, typical 1.
15	Hose	Type: 8 mm (0.31 inch) outer-diameter (O.D.) flexible hose supplied with MCS 5042.
16	Hose	Type: 9 mm (0.35 inch) inner diameter flexible hose supplied with MCS 5042.
17	Filter	1μm filter is recommended for optimal long-term performance of the MCS 5042. A cartridge or bag filter could be used in a full flow or side stream flow configuration. Watts® FM4X2 stainless steel housing or equivalent. Provide dielectric unions on both connections. Provide pleated cartridge rated for 1 μm. Depending on water quality, multiple units in parallel might be required.
18	Manual air vent	Type: 19.05 mm (0.75 inch) two-piece, full-port, brass ball valve with chrome plated brass ball, PTFE seats, and steel handle, with threaded connections. Pressure rating: 600psi WOG, 150psi WSP. Watts® FBV-3C or equivalent
19	Nipple	Type: 19.05 mm (0.75 inch_ brass close nipple.
20	Cap	Type: 19.05 mm (0.75 inch) brass cap with chain.
21	Test plug	Type: Corrosion-resistant brass body with core inserts, gasketed and threaded cap, with extended stem for units to suit piping insulation thickness. Watts® TP or equivalent.

Typical plumbing installation guidelines

- Installation service for this MCS 5042 is order number UE005E.
- Contractors shall install all valves, strainers, and other piping components to the specifications provided in the Chapter 2 section “Piping approaches.” All components shall be readily accessible.
- Contractor shall flush all lines of debris and cap prior to MCS 5042 installation.
- Contractors shall furnish and install Armacell AP/Armaflex® closed-cell elastomeric thermal insulation with minimum 25 mm (1 inch) minimum wall thickness on all customer piping and fittings. Contractors shall furnish and install similar insulation type with minimum 6.4 mm (0.25 inch) wall thickness for MCS 5042 chilled water hoses and fittings. The MCS 5042 hoses have a 45 mm (1.75 inch) outer diameter and a bolt clamp that is 76 mm (3 inches) wide, 57 mm (2.25inches) high and 51 mm (2 inches) deep on the side that must be connected to the infrastructure pipe. All insulation joints shall be taped with AP/Armaflex® Insulation Tape, 3 mm (1/8 inch) thick x 50 mm (2 inches) wide x 9.1 m (30 feet) long. Mitered fittings must be cemented with Armaflex® 520 Adhesive.
- HP MCS 5042 condensate and overflow hoses do not require insulation.
- Filters might require a minimum of 762 mm (30 inches) clearance under the floor for installation. If the filters cannot be installed under the floor due to space constraints, they can be placed upstream of the piping system.

Caution:
The water supply system feeding the MCS 5042 must capable of withstanding the following situations:
– Deadheading (operating with a closed line)
– Operation with rapid and frequent changes in flow requirements
– Operation over long periods of time with zero water flow.

Note:
HP recommends that the HP mc-Series 5042 Hook Up Kit (BW971A) be ordered for each MCS 5042 to be installed.

Coolant requirements

General thermal requirements

Table 8: Facility coolant requirements

Parameter	Value
Allowable operational chilled water temperature [1] Minimum Maximum	 7°C (45°F) Min. 18°C (64°F) Max
Maximum heat load (50kW) operational chilled water temperature [1] Minimum Maximum	 7°C (45°F) Min. 13°C (55°F) Max
Chilled water flow rate (maximum) [1]	Approximately 159 lpm (42 gpm)
Inlet/outlet water connections to MCS 5042 (2) [2]	1.75-inch BSPP (parallel-thread)
Inlet/outlet hose connections to facility	1.25-inch BSPP (parallel-thread)
Hose insulation thickness	6.3 mm (0.25 inch), min. closed cell
Condensate discharge tubing	3 m (118 inch) length, 8 mm (0.31 inch) outer diameter, 6 mm (0.24 inch) inner diameter
Overflow tubing	3 m (118 in) length, 15 mm (0.59 inch) outer diameter, 9 mm (0.35 inch) inner diameter
Chilled water pressure differential at required flow	1 - 1.5 bar (15 – 22 psi) required [3]
Cooling capacity [1]	50 kW Maximum (Performance is affected by water temperature— See Figures 21, 32, and 33.)

[1] For more information, see “Determining heat load capacities.”

[2] For more information, see “Plumbing considerations.”

[3] For more information, see “Determining heat load capacities.”

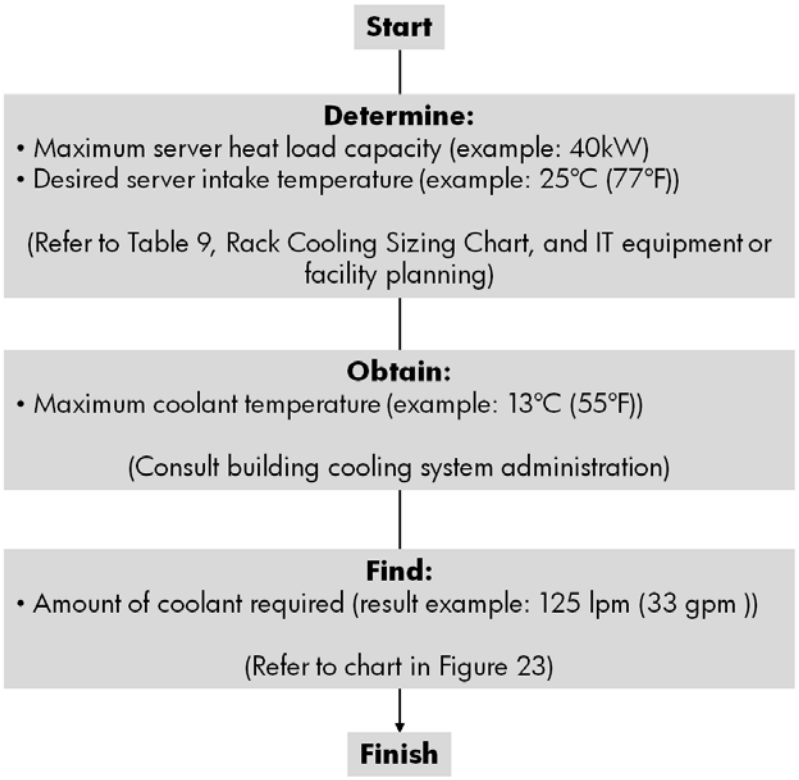
In addition to the requirements listed in Table 8, the coolant must meet the requirements listed “Water quality requirements.”

Caution:
Operating the MCS 5042 below the allowable chilled water temperature should be avoided, because it might cause excessive amount of condensation.

Important:
The MCS 5042 must not be operated with being supplied of a public water system, like drinking water. Only systems that are operating by recycling water to cool the MCS 5042 are highly recommended for proper use.

You must perform several steps to determine the coolant requirements and corresponding resources necessary for effective implementation of the MCS 5042. The flowchart in Figure 31 outlines the steps and necessary information/resources for each aspect of the implementation.

Figure 31: Coolant implementation flow chart for one rack


Start
Determine:
• Maximum server heat load capacity (example: 40kW)
• Desired server intake temperature (example: 25°C (77°F))
(Refer to Table 9, Rack Cooling Sizing Chart, and IT equipment or facility planning)
Obtain:
• Maximum coolant temperature (example: 13°C (55°F))
(Consult building cooling system administration)
Find:
• Amount of coolant required (result example: 125 lpm (33 gpm))
(Refer to chart in Figure 23)
Finish

Cooling loop sizing

Sizing the cooling loops can be straight forward based on the planned cooling requirements of each populated/planned MCS 5042 server enclosure. The amount (watts) of heat to be removed from each component in the server rack must be added together for the total heat to be removed by the MCS 5042 cabinet. You can copy Table 9 for documenting individual cabinet calculations. Calculations must include the equipment installed today and additional equipment planned for installation over the design life of the system.

Table 9: Rack Cooling Loop Sizing Chart

Installed Component	Quantity	Max. Watts Generated	Max. CFM Required	Max. Watts Total	Max. CFM Total
Component 1:					
Component 2:					
Component 3:					
Component 4:					
Component 5:					
Component 6:					
Component 7:					
Component 8:					
Component 9:					
Component 10:					
Total for Cabinet [1]					

[1] An approximate value can be estimated by assuming all power entering the cabinet is converted to heat.

After calculating the total expected required heat load, use the charts in "Determining heat load capacities" to determine required water flow and pressure based on potential chilled water temperatures. The pressure (PSID) must be measured prior to the cold water inlet/after warm water outlet. All water system equipment, materials, and installation must comply with any applicable construction codes and LAHJ.

Determining heat load capacities

The total airflow required by the equipment installed in each server rack must be compared with the total available supply from the MCS 5042, so it is not exceeded. The fans in the MCS 5042 are speed controlled to reduce the airflow in case the maximum cooling capacity is not demanded from the MCS 5042. Table 10 provides a few examples of the approximate fan speeds by the demanded cooling capacity from the MCS 5042.

Table 10: Approximate fan step at certain cooling capacity

Approximate cooling capacity	Approximate fan speed
~9 kW	40–45%
~16 kW	60–70%
~24 kW	75–85%
~32 kW	90–100%
>40 kW	100%

A minimum heat load is necessary for operating the MCS 5042 properly. This minimum depends on the water supply temperature as shown in Table 11.

Table 11: Minimum heat load at different water supply temperatures and server air intake temperature

Server air intake temperature	Water supply temperature	Minimum heat load
20°C (68°F)	7°C (45°F)	9 kW
	10°C (50°F)	7 kW
	13°C (55°F)	6 kW
	16°C (61°F)	6 kW
25°C (77°F)	7–13°C (45–55°F)	16 kW
	16°C (61°F)	14 kW
	18°C (64°F)	10 kW

Note:
When the minimum heat load is not provided to the MCS 5042, it can cause unstable control of the temperatures and flow rates of the MCS 5042.

Consult with your HP representative for further information.

The charts in Figures 32 and 33 offer a guideline for determining the approximate amount of heat that can be removed from MCS 5042 based on 20°C (68°F) and 25° C (77°F) server intake air temperatures (in degrees Celsius) and flow rates (liters per minute (lpm) or in US gallons per minute (gpm)) being delivered to the unit.

Note:
The term "water" in the following charts refers to the coolant described in "Water quality requirements" section.

Figure 32: MCS 5042 coolant flow requirements with 20°C (68°F) server intake air

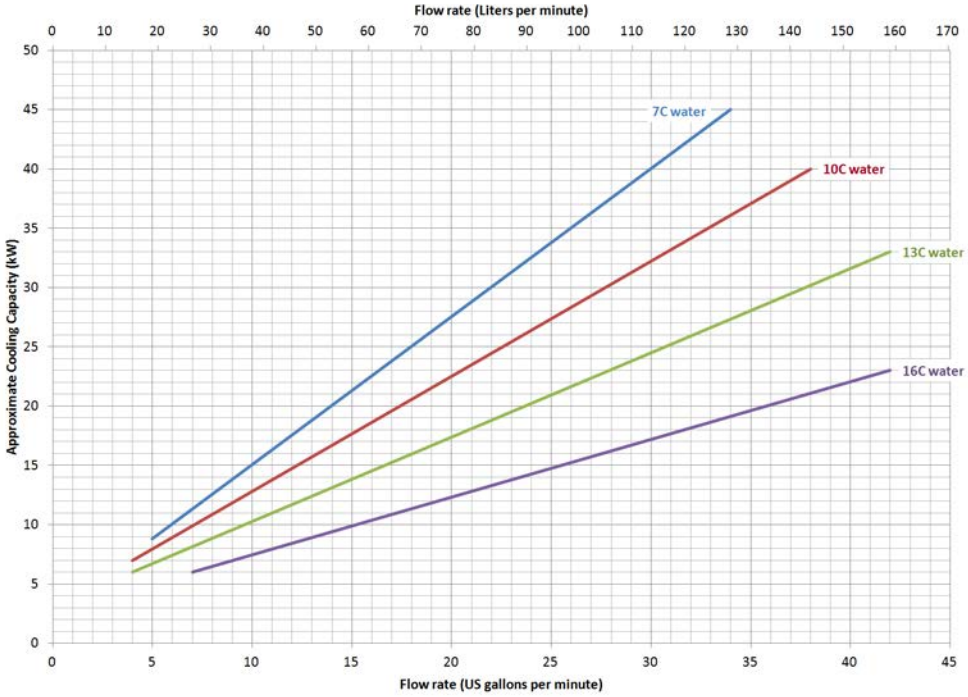
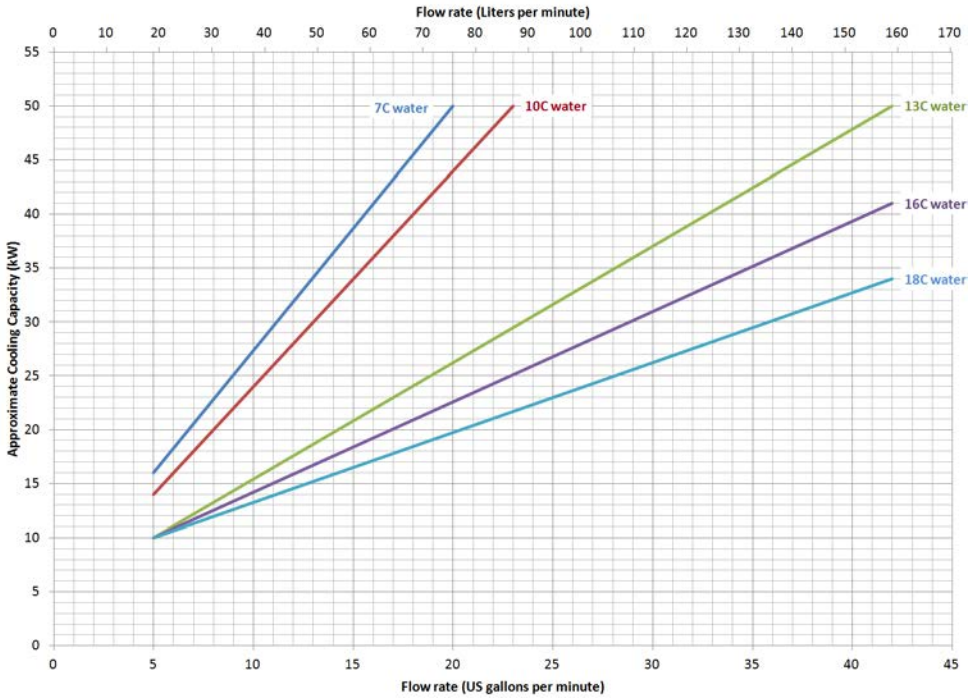
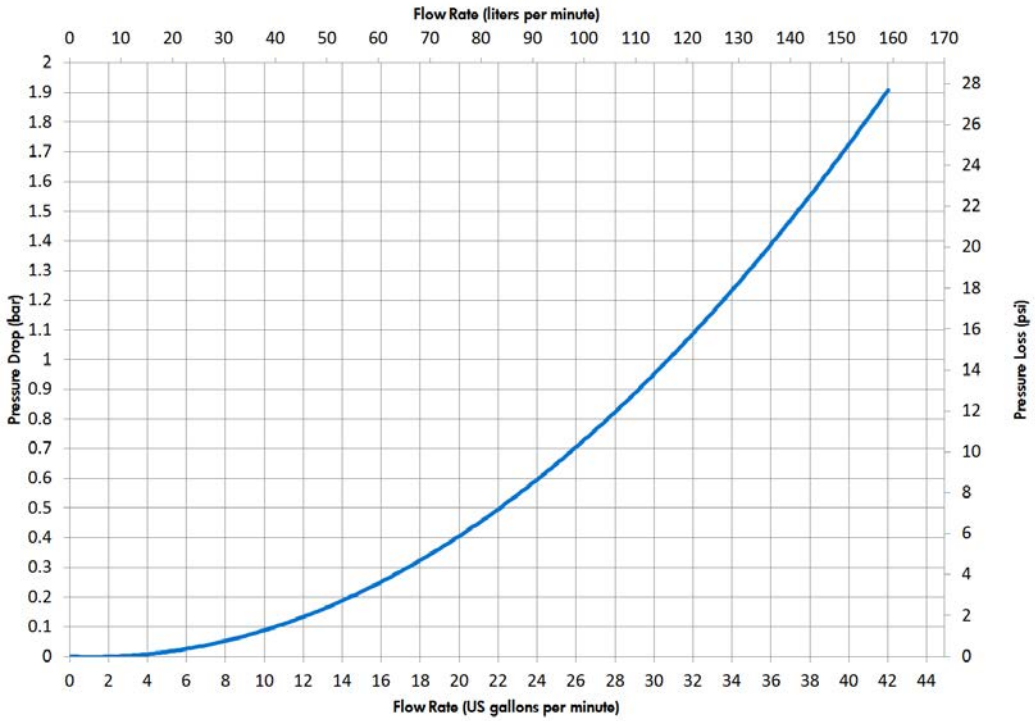

Flow rate (Liters per minute)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170
50 45 40 35 30 25 20 15 10 5 0
Approximate Cooling Capacity (kW)
7C water
10C water
13C water
16C water
0 5 10 15 20 25 30 35 40 45
Flow rate (US gallons per minute)

Figure 33: MCS 5042 coolant flow requirements with 25°C (77°F) server intake air


Flow rate (Liters per minute)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170
55 50 45 40 35 30 25 20 15 10 5 0
Approximate Cooling Capacity (kW)
7C water
10C water
13C water
16C water
18C water
0 5 10 15 20 25 30 35 40 45
Flow rate (US gallons per minute)

The following pressure drop chart in Figure 33 is provided as a reference indicating water flow versus the water pressure for a fully-opened MCS 5042 water control valve.

Figure 34: Flow rate versus delta pressure (water control valve fully open)



A minimum water pressure difference of 1.0 to 1.5 bar (15 to 20 psi) between facility supply and return is required. Figure 34 gives the pressure difference with a fully opened control valve. In operation the control valve is maintaining the water flow to the MCS 5042 by introducing pressure resistance to reduce the flow to accommodate different water temperatures and cooling capacity. This way the pressure loss in operation appears higher than shown in Figure 34. But to have the full scale of water flow available, the provided system pressure difference must be slightly higher than the maximum pressure loss with a fully opened control valve.

Water quality requirements

Closed-loop water must not contain any lime scale deposits or loose debris. The water must have a low level of hardness, particularly a low level of carbon hardness. Filters must be used to remove free floating particulates and regularly maintained. Additionally, the water must not be so soft that it corrodes the materials that it comes into contact. You must periodically add new fresh water, but also you to remove some of the enriched water. HP recommends a #30 mesh filter for filtering water fed to the MCS 5042 and a 1 μm filter for prolonged performance.

Note:
If water quality specifications are out of range, consult a water quality expert.

Table 12: Water quality ranges required for continuous quality of performance for the MCS 5042 liquid cooling system

Parameter	Range (See above note)
pH	7 to 9
Specific Conductance, at 25° C, μmhos	<2500
Sulfur, Total, as SO4, ppm	<100
Chloride, as Cl, ppm	<50
Sulfide, as S, ppm	<10
Hardness, Total, as CaCO3, ppm	<200
Iron, Total, as Fe, ppm	<3.0
Manganese, Total, as Mn, ppm	<0.1
Bacteria, CFUs/ml	<1000
Residue on evaporation, ppm	<500
Turbidity, NTU	20
Corrosion inhibitor	Recommended

Caution:
Contaminated water might cause decreased cooling capacity or disruption in service. The water flowing into the MCS 5042 unit must meet the guidelines stated in the *HP mc-Series 5042 Rack Site Preparation Guide*. Damage caused by contaminated water is not covered by the MCS unit warranty.

Note:
HP recommends that particulate filtration be implemented into the dedicated water supply system feeding each MCS 5042.

Another consideration for water is the required set point. Temperatures near or below 0°C (32°F) indicate that the chilled water plant condenser is very close to or below the freezing point of the water. (The minimum chilled water temperature to be supplied to the MCS 5042 is 7°C or 45°F.) This temperature might cause a blockage and damage to the unit, so an additive like glycol might be necessary to lower the freezing point. However the heat transfer potential of the water is lower, therefore, you must consider proper equipment capacity derating.

In a cooling loop, metallic materials in a pipe distribution network are in constant contact with re-circulating liquid and can react with impurities to cause corrosion that can develop into leaks or form deposits that can develop into blockages.

The rate of galvanic corrosion depends on the electrical potential between the two dissimilar metals and the temperature of the liquid.

Note:
A 10°C (50°F) rise in water temperature can double the rate of corrosion.

Additional water precautions

The following actions must be taken during the installation of the MCS 5042:

- Ensure that all foreign matter and particulates are flushed from the system prior to installing the water kit for the MCS 5042.
- Evaluate the short- and long-term system requirements, versus available water capacity.
- Ensure your chilled water loop is properly designed for liquid cooling systems, separate from the sanitary water systems within your building (such as, bathroom, sink, or drinking water).
- Make sure facility managers are aware of the additional load being added to the building chilled water supply. Be aware that the heat load being added might have an effect on other components being cooled by the chilled water plant.

Caution:
The water supply system feeding the MCS 5042 must be capable of withstanding deadheading (operating with a closed line) and operation with rapid and frequent changes in flow requirements, including long periods of time with zero water flow.

Plumbing materials to avoid

The following materials must not be used with a closed water system:

- Oxidizing biocides
- Aluminum components
- High zinc/brass components
- Non-stainless steel iron components

Environmental considerations

Table 13: Recommended environmental specifications

Parameter	Value
Room Temperature	
Recommended Minimum/Maximum	18°C (64.4°F)/27°C (80.6°F)
Allowable Minimum/Maximum	15°C (59°F)/32°C (90°F)
Humidity:	
Recommended Minimum	5.5°C (41.9°F) dew point
Recommended Maximum	60% relative humidity and 15°C (59°F) dew point
Allowable range	20%—80%

Note:
The temperatures stated are for an elevation of 0 to 5000 feet above sea level. The maximum operating temperatures must be de-rated by 1°C per 1000 feet for locations 5000 to 10,000 feet above sea level.

Control system

The MCS 5042 includes a control system that constantly monitors the air temperatures, water temperatures, and flow rate. The management module attempts to maintain the air temperature at the target set point. If the set point temperature cannot be maintained, the MCS 5042 management module will generate an alarm and notify facility management systems as configured.

Note:
For site evaluations and technical consulting services for your site, see the *HP mc-Series 5042 User Guide*.

Before installing and running active components

Prior to starting up any active components (servers, storage devices, and so on) mounted in the MCS 5042, the following steps must be performed:

1. Ensure that the chilled water source is on and flowing prior to the start-up of an MCS 5042.
2. Ensure that the MCS 5042 is fully operational and running before turning on the servers and closing the front and rear cabinet doors.

Caution:
If the MCS 5042 is left running in manual mode for a period of time without an adequate heat load being generated by servers or other computing and networking devices, excess condensation might occur within the cabinet or system.

For more information on the installation of the MCS 5042, see the MCS 5042 documentation on the HP website (http://h20000.www2.hp.com/bizsupport/TechSupport/DocumentIndex.jsp?contentType=SupportManual&lang=en&cc=us&docIndexId=64179&taskId=101&prodTypeId=3447589&prodSeriesId=3657806).

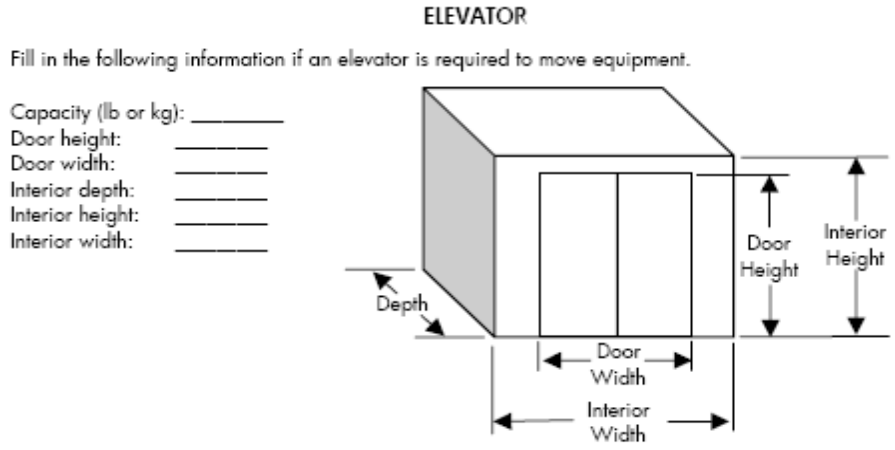
Appendix A Forms and checklists

Delivery survey form

The delivery survey form (Figure 35) lists delivery or installation requirements. If any of the items on the list apply, enter the appropriate information in the areas provided on the form. Special instructions or recommendations must be entered on the special instructions or recommendations form. The following list gives examples of special instructions or issues:

- Packaging restrictions at the facility, such as size and weight limitations
- Special delivery procedures
- Special equipment required for installation, such as tracking or hoists
- What time the facility is available for installation (after the equipment is unloaded)
- Special security requirements applicable to the facility, such as security clearance

Figure 35: Delivery Survey Form



Warning:
To prevent possible serious personal injury or damage to equipment, do not move the MCS 5042 up or down stairs.

Pre-installation checklists

Site preparation checklist

Table 14 is a site preparation checklist. For each item, check Yes or No in the appropriate column. If answering No, include a comment and the date. A No answer means that an alternative might be required.

Table 14: Site preparation checklist

Item	Area/ condition	Yes	No	Comment/ Date
Facility considerations				
1	Is there a completed floor plan, including a detailed location of the MCS 5042 relative to the floor tile breaks and supports?			
2	Is there adequate space for maintenance needs? HP recommends a clearance at a minimum of 1219 mm (48 inches) for the front and a minimum of 914 mm (36 inches) minimum at the rear.			
3	Is access to the site or computer room restricted?			
4	Is the computer room structurally complete? Expected date of completion?			
5	Is a raised floor installed and in good condition?			
6	Is the raised floor system, including needed cutouts, able to adequately support the fully loaded rack and MCS?			
7	Are there channels or cutouts for cable routing?			
8	Is there a network line available?			
9	Is a telephone line available?			
10	Are floor tiles in good condition and properly braced?			
11	Is there a leak detector for the chilled water system? (external to the MCS 5042)			
Power and lighting considerations				
12	Are there AC outlets available for servicing needs? (for example, laptop)			
13	Does the input voltage correspond to MCS 5042 specifications?			
14	Is dual source power used? If so, identify types and evaluate grounding.			
15	Does the input frequency correspond to equipment specifications?			
16	Is power conditioning equipment installed?			
17	Is there a dedicated branch circuit for equipment?			
18	Is the dedicated branch circuit less than 22.86 m (75 feet) away?			
19	Are the input circuit breakers sized to protect their respective receptacles for equipment loads?			
Safety considerations				
20	Is there an emergency power shutoff switch?			
21	Is there a telephone available for emergency purposes?			
22	Is there a fire protection system in the computer room?			
23	Is antistatic flooring installed?			

Item	Area/ condition	Yes	No	Comment/ Date
Cooling considerations				
24	Can the room temperature be maintained between the recommended 18°C (64.4 °F) Min. –27°C (80.6 °F) Max. and allowable 15°C (59 °F) Min. –32°C (90 °F) Max. (up to 5000 ft) Derate 1°C/1000 ft above 5000 ft and up to 10,000 ft			
25	Can humidity level be maintained at the recommended level of 5.5°C (41.9°F) dew point to 60% relative humidity and 15°C (59°F) dew point, with an allowable humidity levels of 20% to 80%			
26	Are air-conditioning filters installed/clean?			
Water preparation considerations				
27	Has the water been tested for acceptable quality for use in the MCS 5042?			
28	If the water quality is unacceptable, have adequate treatment and filtration measures been put into place?			
29	Have the water temperature and flow been evaluated?			
30	If temperature and flow are not adequate, have supplemental chiller units and water pumps been implemented to achieve ample performance?			
31	Has an adequately sized water-to-water heat exchanger been implemented to provide a dedicated water loop to the MCS 5042?			
32	Has piping of an appropriate diameter, material, and pressure tolerance been installed to reach the back of each MCS 5042?			
33	Is there a provision for fluid collected from the condensation and overflow hoses at each MCS 5042?			

Appendix B: Conversion factors and formulas

The conversion factors provided in this appendix are intended to ease data calculation for systems that do not provide information in the format requested in this Site Preparation Guide. The following list includes the conversion factors used in this document, as well as additional conversion factors that might be helpful in determining those factors required for site planning.

Conversion factors for refrigeration

- 1 watt = 0.86 kcal/hour
- 1 watt = 3.412 British thermal unit (Btu)/hour
- 1 ton = 200 Btu/minute
- 1 ton = 12,000 Btu/hour
- 1 ton = 3,517.2 W

Metric equivalents

- 1 centimeter = 0.3937 inch
- 1 meter = 3.28 feet
- 1 meter = 1.09 yards
- 1 inch = 2.54 centimeter
- 1 feet = 0.305 meter
- 1 cubic feet/minute (CFM) = 1.7m^3/hour

kVA conversions

- Three phase kiloVolt-Amps (kVA) = V × A × √3/1000
- Single phase kVA = V × A/1000

Formulas

- kVA = [Voltage x Current (amps)]/1000
- Watts = VA x power factor (PF)
- Btu = Watts x 3.41

Glossary

Table 15: Terms and abbreviations

Term	Description
Apparent power	A value of power for AC circuits that is calculated as the product of RMS current times RMS voltage, without taking the power factor into account.
ASL	Above sea level
Btu/hr	British thermal units per hour. The amount of heat required to raise one pound of water 1°F/hr, a common measure of heat transfer rate.
CFM	Cubic feet per minute, commonly used to measure the rate of air flow in an air-conditioning system.
Chilled water system	A type of air-conditioning system that has no refrigerant in the unit itself. The refrigerant is contained in a chiller, which is located remotely. The chiller cools water, which is piped to the air conditioner or HP Modular Cooling System to cool the space.
Derate	To lower the rated capability of an electrical or mechanical apparatus.
Heat exchanger	Cooling unit that maintains two separate environments inside and outside of the cabinet or room. It can be water-to-water, water-to-air, or air-to-air configurations, in either direction.
Inrush current	The peak current flowing into a power supply the instant AC power is applied. This peak is usually much higher than the typical input current because of the charging of the input filter capacitors. When switching power supplies are first turned on, they present high initial currents as a result of filter capacitor impedance. These large filter capacitors act like a short circuit, producing an immediate inrush surge current with a fast rise time. The peak inrush current can be several orders of magnitude greater than the supply's typical current.
Leakage current	A term relating to current flowing between the AC supply wires and earth ground. The term does not necessarily denote a fault condition. In power supplies, leakage current usually refers to the 60-Hz current, which flows through the EMI filter capacitors that are connected between the AC lines and ground.
Maximum input current	The operating current of the product equal to the maximum load divided by the minimum input voltage.
Power factor	The ratio of true power (watts) to apparent power (VA) in an AC circuit. In power conversion technology, power factor is used in conjunction with describing the AC input current to the power supply.
RMS	Root-mean-square. Term that refers to the most common mathematical method of defining the effective voltage or current of an AC wave. To determine RMS value, three mathematical operations are carried out on the function representing the AC waveform: (1) The square of the waveform function (usually a sine wave) is determined. (2) The function resulting from step 1 is averaged over time. (3) The square root of the function resulting from step 2 is found.
Theoretical maximum power consumption	Maximum wattage of a given configuration, assuming worst-case conditions (thermal tolerances, workloads, and so forth) on all system components. It is extremely unlikely that any customer will experience this level of power consumption.
True power	In an AC circuit, true power is the actual power consumed and is measured in watts. It is distinguished from apparent power by eliminating the reactive power component that might be present
Typical input current	The operating current of the product measured using a typical load and target voltage.

Term	Description
Typical power consumption	Represents the expected power consumption of a given configuration. The typical value is the approximate power consumption that a customer will most likely experience and can use for power budgeting purposes.
Watt	A standard unit of power defined as one Joule of energy transferred or dissipated in one second.

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4AA2-6422ENW, 3rd revision, December 2012